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Agenda item 6: Cross-Cutting Issues - The Integration and Aggregation Rules and Assessment Criteria for IMAP Ecological Objectives 5, 9 and 10

Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster including Analysis of the Compatibility of Updated Monitoring Programmes related to Contaminants, Marine Litter and Eutrophication with IMAP Requirements related to Ecological Objectives 5, 9 and 10

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Note by the Secretariat

In line with the Programme of Work 2020-2021 adopted by COP21 (Naples, Italy, December 2019), the MED POL Programme has prepared a Proposal of Integration and Aggregation Rules for Monitoring and Assessment of National Data for IMAP Pollution and Marine Litter Cluster. The preparation and possible agreement on integration and aggregation rules for monitoring and assessment represents an important milestone of the 2023 MED QSR Roadmap implementation (Decision IG.24/4 of COP21).

With the view to delivering this task, an in-depth analysis was undertaken of the current national monitoring and assessment practices of the Contracting Parties, along with other related best available knowledge and practices. The present document elaborates: i) the methodology for proposing the spatial scales of assessment from the scales of monitoring as defined in national IMAP Pollution and Marine Litter Cluster – based monitoring programmes, considering also the areas of assessment as defined in national MSFD monitoring strategies by the Contracting Parties which are EU Member States; ii) the rules for integration of monitoring and assessment areas within the IMAP Pollution and Marine Litter Cluster (EO5, EO9, EO10), considering also interrelation with the Coast & Hydrography (EO6, EO7) and Biodiversity (EO1) Clusters, therefore detailing the rules for integration of monitoring efforts within relevant monitoring units; iii) the rules for aggregation – integration of assessments for specific IMAP Common Indicators/Ecological Objectives towards integrated GES assessment for IMAP Pollution and Marine Litter Cluster along with application of the assessment criteria and DPSIR approach within the nested scheme.

The present Proposal is submitted for consideration of the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring for its feedback and guidance on the next steps for its application, as appropriate. The Meeting is also expected to endorse its submission for consideration by the Meeting of MEDPOL Focal Points that will be held in May 2021.

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List of Abbreviations / Acronyms

AMU	Additional Marine Unit
BAC	Background Assessment Concentration
BC	Background Concentration
CDR	Central Data Repository
CFP	Common Fisheries Policy
CI	Common Indicator
CHASE	Chemical Status Assessment Tool
COP	Conference of the Parties
CORMON	Correspondence Group on Monitoring
CPs	Contracting Parties
DCF	Data Collection Framework).
EO	Ecological Objective
EU	European Union
GFCM	General Fishery Commission for the Mediterranean
GES	Good Environmental Status
HAB	Harmful Algae Blooms
HEAT	HELCOM Eutrophication Assessment Tool
HELCOM	Baltic Marine Environment Protection Commission - Helsinki Commission
HOLAS	Holistic Assessment of Ecosystem Health Status
ICZM	Integrated Coastal Zone Management in the Mediterranean
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
MAP	Mediterranean Action Plan
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
MED QSR	Mediterranean Quality Status Report
MSFD	Marine Strategy Framework Directive
MRU	Marine Reporting Unit
MSs	Member States
NEAT	Nested Environmental status Assessment Tool
OSPAR	Convention for the Protection of the Marine Environment for the North-East Atlantic
SAU	Spatial Assessment Unit
SPAs	Specially Protected Areas

1. Introduction

1. The Ecosystem Approach (EcAp) (Decision IG 17/6, COP 15; Decision IG 20/4, COP 17; Decision 21/3, COP 18) and IMAP programme (Decision IG.22/7; COP 19) define Good Environmental Status (GES) towards a healthy Mediterranean Sea and coasts, including a sustainable use of the marine resources. In line with the recommendations of the 2017 MED QSR (Decision 23/6, COP 20), the main elements of the ecosystem should be assessed in an integrated manner and closely linked to the effects of pressures from human activities.

2. In the present document: 'Rules for Integration of Monitoring Activities' refer to recommendations for realizing a monitoring scheme that takes into account the interrelationships of CIs and EOs. 'Rules of Integration of Assessments' refer to the principles that underlie meaningful assessments on appropriate scales of assessment. 'Rules for aggregation-integration of GES assessments' refer to the methods (i.e., numerical calculations) for combining data in order to produce findings on the status of a specific area of assessment.

3. The use of 'aggregation' and 'integration' in the concept of GES assessment methods has been introduced by Borja et al (2014)[1]. The term aggregation is used for the combination of comparable elements across temporal and spatial scales, indicators and criteria, within a descriptor. The term integration is used for the combination of different elements (e.g., across descriptors) to produce a single value of GES as a whole. Under this concept, which is also followed by the MSFD documents, integration is conceived only across descriptors and in the ecosystem space as a whole.

4. For the purposes of IMAP implementation, there is a need of defining the temporal and spatial scales of the assessments. In relation to the scales of assessment for EO5 and EO9, the Meeting of CorMon on Pollution Monitoring, held on 2-3 April 2019, in Podgorica, Montenegro, has pointed out that the scales of monitoring should be considered along with the scales of assessment as a condition to define the "adequate" nested approach of the monitoring units into assessment scales[2]. The nested approach ensures that a balance is achieved between a too broad scale, that can mask significant areas of impact in certain parts of a region or subregion, and a very fine scale that could lead to very complicated assessment processes.

5. Within a nested approach, the two types of scales (i.e., scales of monitoring and scales of assessment) are interrelated, however a clear description of them should be made for a better comprehension of this interrelationship. The scales or units of monitoring refer to the physical spatiotemporal space where the observations are made (or samples taken) i.e., the points in time and space which are monitored. Monitoring scales are usually defined upon significance of the environmental parameters that are monitored, the expected variability and the types of pressures posed on a particular area/habitat. The parameters monitored within a specific monitoring unit may reflect the environmental conditions/impacts/extent of impacts of the monitoring unit itself or the environmental conditions/ impacts/ extent of impacts of a larger unit. For example, at a coastal monitoring unit, enterococci in bathing waters reflect the environmental conditions of the monitored unit, while observations of stranded entangled animals on a beach do not reflect the environmental conditions of the coastal monitored unit, but rather of a greater area. In that sense the information retrieved from monitoring data (i.e., assessment findings) may correspond or may be interpreted to different spatial scales from those the monitoring takes place. So, the scales of monitoring may differ from the scales of assessment and this depends on the ecological significance of the parameters/elements/Common Indicators (CI) monitored.

6. Within implementation of IMAP, the Contracting Parties to Barcelona Convention (CPs) are obliged to report the data produced in a specific format, as defined in IMAP Data Dictionaries (DDs) and Data Standards (DSs)[3] that allows for the assessment of state or impact for a spatial unit and subsequently for GES for the Mediterranean Sea as a whole. For each group of parameters, the areas are defined where monitoring takes place; these are the monitoring units. From the monitoring units the areas of assessment can be then defined by applying relevant criteria, e.g. representativeness/importance of the areas of monitoring for establishing

[1] Borja A., Prins T.C., Simboura N., Andersen J.H., Berg T., Marques J.-C., Neto J.M., Papadopoulou N., Reker J., Teixeira H. and Uusitalo L. (2014) Tales from a thousand and one ways to integrate marine ecosystem components when assessing the environmental status. *Front. Mar. Sci*., 1:7 2. doi: 10.3389/fmars.2014.00072.
[2] UNEP/MAP (2019). UNEP/MED WG.463/8. Approaches on Scales of Monitoring for Common Indicators related to pollution.
[3] UNEP/MAP (2019a). UNEP/MAP 467/9. Data Standards and Data Dictionaries for Common Indicators related to Pollution and Marine Litter

areas of assessment; presence of impacts of pressures in monitoring areas; sufficiency of quality assured data for establishing the areas of assessment covering as many as possible IMAP Common Indicators to the extent possible, and ensuring that adequate consideration is given to the risk based principle (both in pristine areas and areas under pressure). Taking into consideration these criteria may not necessarily lead to the assessment areas compatible with the national/local administrative geographical divisions.

7. The harmonization of the scales approach between the CPs is the starting point for the integration process i.e., to scale up the marine assessment to sub-regional and regional scales as required under IMAP. In order to support harmonization, there is a need to define Integration Rules for Monitoring Activities, which refer to a set of guidelines[4] that should be followed when implementing monitoring programmes, in order to produce coherent data sets that will facilitate the subsequent process of nested GES assessments. The harmonized application of the nested approach requires also defining Integration Rules for Assessments. Given the differences among the EOs, these rules can be better defined on the IMAP Cluster level taking into consideration the interrelationships of CIs within the same and across other clusters of the IMAP. Interrelationships between the IMAP Ecological Objectives respectively the IMAP Common Indicators and status of the ecosystem elements and impacts of pressures are important to ensure the integrated assessment of GES.

8. The final step for an ecosystem-based integrated approach is to determine and assess GES based on the data derived from the monitoring programmes. Due to the complexity of the marine ecosystems one single value will never appropriately reflect the physical, chemical, biological and societal aspects that need to be combined, yet it is useful for the development of the management plans and policies. For this purpose, various aggregation approaches and methodologies for GES assessment have been developed. These refer to the methods (i.e. numeric calculations) applied in order to combine measured parameters/elements of specific IMAP CIs within EOs and then across EOs to eventually result in an assessment of GES for a specific area of assessment. The methods need to be easy to communicate to managers and policy makers without oversimplifying the information. Care should be taken that information is not lost/obscured/masked during the aggregation/integration process and all the steps can be clearly tracked. This is particularly important for targeting policy measures. In addition, it is advisable that the assessment method can provide the degree of uncertainty for a particular assessment. Uncertainty of assessments is related to the disproportional information regarding monitoring data obtained per CIs/EOs and/or spatial coverage.

2. Comparative analysis of national IMAPs regarding implementation of EO5, EO9 and EO10

9. A fundamental step of IMAP implementation was setting up a new generation of national monitoring programmes aligned with IMAP during a period 2018-2019. The national monitoring networks for IMAP Pollution and Marine Litter Cluster were established by applying IMAP requirements and considering the knowledge and practices obtained over 40 years of MED POL monitoring implementation by the CPs.

10. The findings provided in present document resulted from the analysis of national IMAP – based monitoring programmes of Algeria, Bosnia and Herzegovina, Egypt, Israel, Lebanon, Libya, Montenegro, Morocco and Tunisia prepared with assistance of UNEP/MAP including under EU funded ECAP MED II Project and GEF Adriatic Project during period 2018-2019, as well as monitoring programmes prepared by the Contracting Parties that are EU Member States within 1st cycle of MSFD implementation. The most important findings in the context of applying integration and aggregation rules are elaborated here-below as well as a detailed analysis on the compatibility with the IMAP requirements of updated monitoring programmes related to contaminants, marine litter and eutrophication prepared in line with the Marine Strategy Framework Directive (MSFD).

a) National IMAP-based monitoring programmes of the Contracting Parties

11. The MED POL IV pollution monitoring programmes concerning eutrophication and contaminants, that correspond to IMAP EO5 and EO9, have been generally focused on narrow coastal areas, whilst monitoring efforts under IMAP are extended to offshore areas including the three matrixes[5]. Collection of biota (e.g.

[4] To that effect Monitoring Guidelines/Protocols for IMAP CIs 13, 14, 17 and 20 have been discussed and agreed by the Integrated Meetings of CorMons organized 1-3 December 2020; whilst the Monitoring Guidelines/Protocols for IMAP CI 18, as well as for Analytical Quality Assurance and Reporting of Monitoring Data for IMAP Pollution related Common Indicators are submitted for consideration to present Meeting.

5 According to IMAP requirements, seawater is not included in the mandatory matrices to be analyzed in the framework of IMAP. At this stage of IMAP implementation, it is recommended that seawater monitoring is carried out on a country decision basis, including contaminants that countries

bivalves, fish), sediment and water samples in offshore areas are challenging operations that require research/adequate vessels, heavy sampling equipment, detailed planning and additional financial resources. Reference, main coastal and hotspot stations, as established within MED POL IV monitoring programmes in narrow coastal water strips remain within new national IMAP-based monitoring programmes. Whilst number of sampling locations is reduced in narrow coastal strip, therefore also contributing to the cost effectiveness of monitoring efforts, the new monitoring areas and transects are established in offshore areas, in order to enlarge geographical scope of monitoring programmes, in accordance with IMAP requirements. The mutual alignment of the national IMAP-based monitoring programmes considers new spatial scales, as defined in relevant IMAP Guidance Fact Sheets[6], as well as a need to correlate pressures, status and impacts (ca. DPSIR framework). Spatial and temporal scales of monitoring related to IMAP Pollution and Marine Litter Cluster are also integrated with other relevant EOs, to the extent possible, with the aim to support integrated and holistic assessment of the Good Environmental Status (GES) of marine environment.

12. With regards to the temporal scales for monitoring eutrophication and chemical pollutants, it must be noted that frequency of monitoring activities as defined in the relevant IMAP Guidance Fact Sheets (UNEP/MAP 2019 c), resulted in the balance of both program requirements and actual capabilities, after almost four decades of MED POL Programme implementation in the Mediterranean Sea by the CPs. In line with IMAP requirements, temporal scales for eutrophication respond to minimum seasonal episodes (i.e. spring and winter in the Mediterranean Sea), and yearly for chemical pollution.

13. The analysis of information on the CPs` national monitoring networks for IMAP Pollution and Marine Litter Cluster allows for detecting the commonalities and differences among them. All the new national networks of monitoring stations/areas are aligned with IMAP requirements. They are built to great extent on the relevant common criteria, therefore significant differences among CPs were not observed.

14. Almost all countries have previous experience regarding EO5 and EO9 requirements through past national monitoring programmes prepared and implemented within MEDPOL IV. The requirements in monitoring the CIs of EO10 are new to all countries, with no previous or limited expertise or data exist. The spatial coverage of monitored stations is well designed allowing for full integration of EO5, EO9 and EO10.

15. With regard to the current national IMAPs implementation, the CPs define data monitoring and reporting on the level of pollution, without always establishing links with the sources and causes, as well as direct and indirect effects. For example, for CIs17 and CI18 not all sub-indicators are measured or planned for measurement in systematic manner or in all relevant matrixes (biota and sediment) for CI17. In many cases it is not clear if levels of contaminants in commonly consumed seafood (CI20) are systematically measured (or planned for measurement) and if number of contaminants, which have exceeded maximum regulatory levels are occasionally detected and reported. The percentage of intestinal enterococci concentration (CI21) are generally measured in compliance with the standards, but discrepancies are observed regarding the temporal scales of monitoring. Trends in the amount of litter washed ashore and/or deposited on coastlines (CI22) and in the water column including microplastics and on the seafloor (CI23) are recent parameters and considerations for several Mediterranean countries are in the initialization stage.

16. Regarding time scales, most monitoring programmes considered appropriately the time frame and the risk-based approach, and high-pressure areas and sensitive areas are identified for monitoring as prioritized areas. However, it should be pointed out that the integration of risks is not fully ensured within all national monitoring programmes.

17. Overall, it can be considered that eutrophication parameters, as well as the parameters related to the concentration of heavy metals/organic compounds in surface sediments are currently monitored by the CPs at relatively acceptable level, whereas marine litter can be considered as a recently introduced set of monitoring parameters for IMAP. There is a very good compliance between the EO5-EO9 monitoring stations/areas in most cases and frequently but not as often as for EO5 and EO9, the EO10 monitoring sites are close to an area that is subject to pollution monitoring. The current national IMAP-based monitoring programmes do not specify how the integration/aggregation needed for assessing GES should be carried out.

consider more appropriate and technically feasible to be monitored, whilst seawater pollution is an issue of concern that might be introduced at later stage of the IMAP implementation.

6 UNEP/MAP (2019 c). UNEP/MAP WG.467/5. IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21; New proposal for Candidate Indicators 26 and 27.

18. From the comparative analysis of the National Pollution and ML IMAPs, it appears that the monitoring interconnections of Pollution and Marine Litter Cluster with the Biodiversity and the Coast and Hydrography Clusters, have not been taken into consideration. Although it appears that monitoring activities take place in similar spatial units, there is a need to coordinate efforts towards this direction. Relevant national groups of experts should take into consideration the spatial coverage of all three IMAP Clusters and define clearly the areas of overlapping activities. In chapter 3 below, monitoring interconnections among EOs of all Clusters are explained and should be taken into consideration.

19. Detailed analysis of national IMAP monitoring plans has showed the following commonalities and differences per CI:

- For EO5, CI13 and CI14 all parameters and sub-indicators are monitored or have been defined for monitoring; by most CPs. Morocco and Tunisia do not cover all mandatory parameters. Temporal scales are well harmonized among countries. Only two countries have already defined the scales according to the type of waters (Lebanon, Montenegro), the rest will do so during the 1st implementation phase.
- For EO9, CI 17 all mandatory parameters are covered in sediments and biota by almost all CPs. Morocco and Tunisia do not cover all organic contaminants, Israel does not cover the biota matrix. Temporal scales are fully harmonized for all countries. The species monitored are not always specified.
- For CI18 previous expertise is limited and some of the countries (Lybia and Israel) have chosen not to cover this CI during the 1st stage of IMAP implementation. Temporal scales as planned have slight differences.
- For CI19 all countries plan to follow the recommendations by REMPEC, Libya is planning this activity for the 2nd implementation phase, while Israel does not provide any relevant information.
- For CI20 all countries plan to monitor contaminants in seafood, except Libya is planning this activity for the 2nd implementation phase. However, only 2 countries (Israel and Lebanon) specify in detail the species they plan to monitor. Also, temporal scales are not always clearly defined whether sampling refers to annual or two times per year. Another point, which is not clearly stated, is whether seafood specimens will be relied on IMAP samplings from fisheries or purchased from fishermen or from both.
- For CI21 all countries have previous expertise except Libya. In Lebanon, other microorganisms were measured in the past (coliforms), enterococococci are currently measured for the needs of IMAP.
- The requirements in monitoring the CIs of EO10 are new to all countries. No previous expertise or data exist.
- CI22 is planned to be covered by all countries but the temporal coverage is still not defined in some cases (Algeria, Israel, Lebanon).
- CI23 mandatory parameters cover macro- litter on the seafloor and floating micro-litter . Two of the countries (Algeria and Morocco) do not plan to cover this CI at all. Floating micro- is planned by Tunisia, Libya, Lebanon, Israel and Bosnia & Herzegovina, floating macro- by Lebanon, Bosnia & Herzegovina and Montenegro. Micro litter in sediments is planned by Israel only. Macro litter on the seafloor is planned by Tunisia, Israel, Lebanon, Egypt, Bosnia & Herzegovina and Montenegro, all of these countries covering litter in shallow seafloor (by scuba diving or ROVs); while 2 out of 6 countries plan an additional sampling in deep seafloor (using fish trawls) (Tunisia and Montenegro). The temporal coverage is not clearly stated in the national IMAPs of some CPs.
- CI24 is not discussed at all for the 1st implementation phase.

20. Detailed analysis of national IMAP monitoring plans has showed the degree of IMAP requirements adoption and /or implementation in all contracting CPs and main gaps have been identified. In the following Tables provided per each country, the degree of compliance of specific National Pollution Cluster IMAP to IMAP requirements is noted by a specific colour: i.e. green- full compliance; orange - Partial compliance; red - Low compliance.

21. **Algeria:** The historical monitoring network in Algeria has been considered as a basis to revise the monitoring areas and select the off-coast transects. A good spatial coverage has been achieved in the new IMAP monitoring programme with 21 new stations for EO9 and 27 new stations for EO5, within 9 sampling

transects/sampling sites in 12 revised monitoring areas. From a geographical point of view, the added sampling locations cover both the different geomorphologic characteristics of the Algerian coast either in natural conditions, including two MPAs, or under anthropogenic pressures according the CIs. Nine transects include joint monitoring for EO5 and EO9 in 18 stations (ca. stations located in offshore). In addition, 4 coastal and 1 offshore sampling locations also includes joint monitoring for EO5 and EO9. Algeria is one of the few countries that propose a stratification of marine space for monitoring EO1 in relation to risks including also pollution risks. The main gaps identified are: i) limited coordination with the numerous existing observatories, institutions, universities, government laboratories along the coastal Algerian provinces with capacity for participating in the IMAP implementation; ii) the consolidation and alignment of the current practices, capabilities and expertise for some CIs might be needed in few cases to deliver routine measurements and IMAP dataflows. ii) Details are not provided for some CIs monitoring plans. iii) Interconnections with other EOs from the Biodiversity and Coast and Hydrography cluster are missing. There is no clear definition of common monitoring areas for Biodiversity and Pollution & ML Clusters, in the National IMAPs for the Pollution and Marine Litter Cluster. Also, no information is available regarding the interconnections with the Coast and Hydrography Cluster.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Algeria	CI13	YES, all parameters	Seasonal	Good spatial integration for EO5, EO9, EO10 and weak for EO1, EO8.
	CI14	YES, all parameters	Seasonal	
	CI17	YES, all parameters	Sediments biannually biota annually (*Mytilus galloprovincialis*)	
	CI18	YES, for SML, AchE, micronuclei	Annually (*Mytilus galloprovincialis* or *Mullus barbatus*)	
	CI19	YES	*Not applicable*	
	CI20	YES (bivalves)	No information available	
	CI21	YES	Bathing season According to IMAP guidance fact sheets	
	CI22	YES	No information available	
	CI23	NO		
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

22**. Bosnia & Herzegovina:** The short coastline of the country (~ 20km) limited within the Gulf of Neum, in the Adriatic Sea is a key factor for the IMAP monitoring plan which does not include transect stations. Two coastal stations are established for EO5 in relation to sources as well as 6 stations for CI17 and 3 for CI18 and CI19 respectively. For CI21 the protocol recommended by the relevant IMAP guidance fact sheets, is not followed. For EO10, 2 stations are monitored for CI22, 2 for CI23 seafloor litter and 1 for CI23 floating litter. The interconnection of the Pollution Marine Litter Cluster with the Biodiversity and Coast and Hydrography clusters is not clearly stated, however it is most likely that monitoring areas coincide for all IMAP clusters due to the small marine national part for this country.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Bosnia & Herzegovina	CI13	YES, all parameters	bi-monthly	Good spatial integration for EO5, EO9, EO10 no information for EO1, EO7, EO8
	CI14	YES, all parameters	bi-monthly	
	CI17	YES, All parameters	sediments biannually biota annually	
	CI18	YES, for SML, AchE, micronuclei	annually	
	CI19	YES	*not applicable*	
	CI20	*Not applicable*	*not applicable*	
	CI21	YES	5 times from June to August	
	CI22	YES	seasonal	
	CI23	YES, for floating macro- & microplastics; seafloor macro- (scuba)	not defined yet	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

23. **Egypt:** The historical monitoring network in the Mediterranean part of the Egyptian coast has been considered as a basis to select the new monitoring areas and the offshore-coastal transects. For the Egyptian coastline, all the proposed monitoring stations could be considered as a revision of the current sampling stations and monitoring areas within present Egyptian monitoring programme. However, 6 monitoring areas have been complemented with sampling transects, therefore, 12 additional sampling sites have been included in offshore areas. From a geographical point of view, the 6 transects cover both the different geomorphologic characteristics of the Egyptian coast (desert-sea, wetland-sea, river-sea transitions); adjusted to the continental platform characteristics in terms of depth and practical distances from the coast, whilst the main sources of pressures, from the west to the east are addressed. Two of the sampling transects are positioned in front of wetland protected areas & Ramsar sites. Joint monitoring efforts related to EO5 and EO9 will be ensured at the offshore stations in all 6 monitoring transects. Eutrophication (EO5) and chemical contaminants (EO9), namely, micronutrients, chlorophyll-a, heavy metals (ca. mercury, cadmium and lead) and organic compounds (organochlorinated compounds and polycyclic aromatic hydrocarbons) will be monitored as well as EO10 parameters, CI22 beach litter, CI23 seafloor macro-litter with scuba diving. The main gaps identified are: i) the

lack of synchronized and well-coordinated implementation of present Egyptian practices; ii) Despite the fact that Biodiversity (EO1) and in particular habitat mapping is being implemented in compatible monitoring areas, there is no reference to it in the National IMAPs for the Pollution and Marine Litter cluster. Also, no information available regarding the interconnections with the Coast and Hydrography cluster.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Egypt	CI13	YES, all parameters	seasonal	Good spatial integration for EO5, EO9, EO10 no information for EO1, EO7, EO8
	CI14	YES, all parameters	seasonal	
	CI17	YES, all parameters	sediments biannually biota annually (no clear info on species)	
	CI18	YES, for SML, AchE, micronuclei	annually	
	CI19	YES	*not applicable*	
	CI20	No information on species monitored	annually	
	CI21	YES	bathing season, according to IMAP guidance factsheets	
	CI22	YES	semester	
	CI23	seafloor macro- (scuba)	not defined yet	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

24. **Israel:** The ongoing National Marine Monitoring Progamme since 1970, has been adapted according to IMAP requirements. There is a good coverage of EO5 stations (40 coastal stations and 7 offshore), and EO9 stations (28 coastal and 17 offshore for CI17; 15 stations for CI20). Regarding the parameters measured the programme the new IMAP programme includes organic contaminants (CI17), not previously monitored, but not biological effects for the needs of CI18. Still the biota matrix, which is mandatory, is not covered for the needs of CI17. For CI21 the relevant protocol recommended by the IMAP guidance factsheets, is not followed. For EO10 the plan is still not fully defined and implemented. Israel is one of the few countries that propose a stratification of marine space for monitoring EO1 in relation to risks including also pollution risks However, the summary of National Pollution and ML Cluster that are available in English, does not provide clear definition of common monitoring areas r Also, no information is available regarding the interconnections with the Coast and Hydrography Cluster.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Israel	CI13	YES, all parameters	semester	Good spatial integration for EO5, EO9, EO10 no
	CI14	YES, all parameters	semester	

	CI17	YES, all parameters	sediments, waters annually, biota not covered	information for EO1, EO7, EO8
	CI18	NO		
	CI19	YES	*not applicable*	
	CI20	YES, for *Pattela sp.* and *Cellana rota* and the bivalves *Mactra stultorum* and *Donax sp*., and fish	No-information available	
	CI21	YES	weekly	
	CI22	YES	not-defined yet	
	CI23	YES, for floating microplastics; sediment microplastics; scuba for macro- on the seafloor	not-defined yet	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

25. **Lebanon:** The historical monitoring network in Lebanon has been considered as a basis to select the revised and new monitoring areas and the offshore-coastal transects. There are 20 new sediment sampling locations within 10 defined transects in the Lebanese offshore area to fulfill the IMAP requirements. Further, for microbiology one complete transect in Beirut (Manara) and the offshore station (A3) have been included. From a geographical point of view, the 11 transects and coastal stations cover both the different geomorphologic characteristics of the Lebanese coast from north to south, as well as the main identified anthropogenic pressures. All the measurement areas contemplate joint monitoring between EO5 and EO9, with a few exceptions: EO5 (Batroum) and EO9 (Byblos and Jounieh) with independent monitoring. Two measurement areas with transect sampling were placed in relevant natural protected areas. Nutrients, chlorophyll-a, heavy metals (ca. mercury, cadmium and lead) and organic compounds (organochlorinated compounds and polycyclic aromatic hydrocarbons) will be monitored and assessed. Regarding EO10 parameters, the spatial (sampling stations) and temporal scales of monitoring should be defined. Main gaps identified include the following: i) Despite the fact that the proposed IMAP plan shows a good compliance with IMAP requirements, most of the parameters selected for monitoring were not previously operational. There is a need for an overarching integration of the national current practices and monitoring programmes along with the requirements related to the capabilities and expertise for some CIs as to ensure new IMAP is performed in a routine basis.; ii) Lebanon is one of the few countries that associate Biodiversity Cluster with the Pollution Cluster within National Biodiversity IMAP. However, there is no reference to it in the National IMAPs for the Pollution and Marine Litter Cluster. Also, no information is available regarding the interconnections with the Coast and Hydrography Cluster.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Lebanon	CI13	YES, all parameters	monthly, seasonal depending on the station type	Good spatial integration for EO5, EO9, EO10

	CI14	YES, all parameters	monthly, seasonal depending on the station type	no information for EO1, EO7, EO8
	CI17	YES, all parameters	sediments biannually, biota annually	
	CI18	YES, for SML, AchE, micronuclei (*Brachodontes pharaonis* and *Mullus barbatus*)		
	CI19	YES	*not applicable*	
	CI20	YES, for *Mullus barbatus* "red mullet", *Diplodus sargus* "white seabream", *Euthynnus alletteratus* "little tunny"	annually	
	CI21	YES	1st phase: seasonal 2nd phase ; according to the IMAP guidance factsheets	
	CI22	YES	not defined yet	
	CI23	YES, for floating macro- & microplastics; seafloor macro- (ROV)	not defined yet	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

26. **Libya:** The available literature datasets have been taken into account to select the new monitoring areas and the off shore-coast transects. Initially, the baselines should be confirmed with a systematic monitoring set up, to allow the extension of the network/transect surveys. For the Libyan coastline, all stations are defined in new monitoring areas and sampling sites, as a routine monitoring does not exist in terms of marine pollution monitoring (EO5 and EO9), despite scattered studies and research performed in Libya. This is also true for marine litter were all the selected measurement areas (i.e., beaches) are newly selected (EO10). From a geographical point of view, the whole Libyan coast and offshore areas have been included in the new IMAP monitoring sampling network from the Western to the Eastern part adjusted to the continental platform characteristics. To this regard, some of the proposed stations (stations within transects) are between 10-20 km off the coast, particularly in both extremes of the Libyan coast, where the continental shelf is much larger with slopes of 1%, and therefore lower depths. In 2 of the monitoring areas there are stations close to MPAs. All 10 transects contain joint monitoring indicators for EO5 and EO9. In addition, 4 out of the 5 coastal beaches (CI22, EO10) are included in these monitoring transects, as well. In this way a cost-effective monitoring is established. The monitoring will include chemical contaminants (EO9), namely heavy metals (ca. mercury, cadmium and

lead) and organic compounds (organochlorinated compounds and polycyclic aromatic hydrocarbons). The main gaps identified are: i) low to medium financial resources to cover the gaps in expertise, sampling logistics and scientific material resources to implement the IMAP monitoring; ii) monitoring plan is still not fully defined and implemented also for the other clusters; ii) interrelations with the Biodiversity Cluster (EO1) are very weakly described in the National Biodiversity IMAP.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Libya	CI13	YES, all parameters	seasonal	Good spatial integration for EO5, EO9, EO10 no information for EO1, EO7, EO8. MPAs have been considered in the selection of stations for EO9.
	CI14	YES, all parameters	seasonal	
	CI17	YES, all parameters	sediments biannually, biota annually (bivalves)	
	CI18	Planned for 2nd phase: SML, AchE, Metalothionins	annually	
	CI19	Planned for 2nd phase	*not applicable*	
	CI20	Planned for 2nd phase	not defined yet	
	CI21	Planned for 2nd phase		
	CI22	YES	seasonal	
	CI23	Yes for floating microplastics	not defined yet	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

27. **Montenegro:** The existing monitoring programmes have been adapted and upgraded according to the IMAP requirements. This is particularly relevant for monitoring of eutrophication and contaminants, where monitoring efforts are extended to offshore areas and changes in monitoring protocols are introduced. This includes defining the new codes for the monitoring stations, in line with IMAP. Also, the systematic approach towards monitoring of hydrographic conditions is introduced in its entirety. There is a very good interconnection of Pollution and Marine Litter Cluster with the Biodiversity and Coast& Hydrography Clusters, in terms of monitoring areas. No major gaps are identified.

Contracting Party	**IMAP CI**	Proposed IMAP plan	Temporal scales	Spatial scales
Montenegro	CI13	YES, all parameters	monthly, seasonal depending on the station type	Good spatial integration for EO5, EO9, EO10 and for EO1, EO7, EO8
	CI14	YES, all parameters	monthly, seasonal depending on the station type	
	CI17	YES, all parameters	sediments biannually, biota annually	

	CI18	NO, only for AchE, micronuclei	semester	
	CI19	YES	*not applicable*	
	CI20	YES, but species not defined	semester	
	CI21	YES	bathing season, according to IMAP guidance factsheets	
	CI22	YES	3 times per year	
	CI23	YES, for Floating macro-; seafloor macro- (MEDITS trawling) Floating micro-not covered	2 times per year	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

28. **Morocco:** Within the historical monitoring programme there were 5 monitoring areas with a single sampling location (although shifted time to time within the area), as well as 3 protected areas. In the new IMAP there will be 7 monitoring areas; 5 of them with stations in offshore located in 3 sampling sites/ transect/radials. In total there will be 12 new monitoring stations respectively 2 offshore stations for each radial and 2 new coastal sites for 2 new measurements areas, for both EO5 and EO9. With respect to EO10 there are new 6 beaches selected from previous studies and 5 sampling sites within the new radials to monitor and assess the EO10. The distribution of the selected beaches for EO10 provides good spatial scale. Two new transects and coastal monitoring sites were added, ensuring the Moroccan coastline to be better assessed in term of spatial scales. Ten out of 15 new stations are jointly monitored for EO5 and EO9, as well as 5 of 15 are jointly monitored for EO5, EO9, EO10. In this way a cost-effective monitoring is established. The main gaps identified are: i) low to medium financial resources to cover the gaps in expertise and material resources, and ii) a higher degree of organizational structure is needed to address effectively the delivery of datasets towards a revision in a second IMAP cycle; iii) Despite the fact that Biodiversity (EO1) and in particular habitat mapping is being implemented in compatible monitoring areas, there is no reference to it in the National IMAPs for the Pollution and Marine Litter cluster. Also, no information available regarding the interconnections with the Coast and Hydrography cluster.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Morocco	CI13	NO, not all parameters	seasonal	Good spatial integration for EO5, EO9, EO10 no information for EO1, EO7, EO8
	CI14	YES, all parameters except pH	seasonal	
	CI17	NO, not all Organic contaminants covered	sediments biannually, biota annually (*Mytilus galloprovincialis*)	
	CI18	NO, only SML	annually	
	CI19	Planned for 2nd phase	*not applicable*	

	CI20	Planned for 2nd phase	no information provided	
	CI21	YES	bathing season, according to IMAP guidance factsheets	
	CI22	YES	1st phase: semester; 2nd phase: seasonal	
	CI23	YES, for Floating macro-; seafloor macro- Floating micro-not covered		
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

29. **Tunisia:** The historical monitoring network in Tunisia has been considered as a basis to revise the monitoring areas and select the off-coast transects. A good spatial coverage has been achieved with 6 new monitoring areas out of 10, with a total of 24 sampling sites. Three of them correspond to new transect joint sampling strategy for EO5 and EO9 and the other three are coastal sites specific for pollution (EO9). The 4 remaining monitoring areas correspond to historical MED POL sites updated with transect sampling. The 7 transects include joint monitoring for EO5 and EO9. From a geographical point of view the coverage of the Tunisian coastline and offshore area is covered in terms of a long-term monitoring program purpose. To mention, the transect sampling in Cap El Ahmar and Zarzis have been included as reference areas. In addition, some of transect sampling areas are close to 2 special nature sites, a National Park, and a Ramsar site located outside the lagoon in the marine part. From an indicator point of view, all CIs for EO5, EO9, EO10 are covered, however for EO10 the temporal scales are not defined yet. In addition, the monitoring plan for CI20, related to regulatory limits of contaminants in seafood for human consumption, is mixed with biological effects and includes also non-edible species such as marine mammals. It is recommended that the monitoring plan for CI20 is limited to the requirements of this CI and explains clearly the acquisition of data on contaminants and the species monitored. The main gaps identified are: i) low to medium financial resources to cover the gaps in expertise and material resources; ii) a higher degree of organizational structure is needed to address effectively the delivery of datasets towards a revision in a second IMAP cycle; and iii) Despite the fact that Biodiversity (EO1) and in particular habitat mapping is being implemented in compatible monitoring areas, there is no reference to it in the National IMAPs for the Pollution and Marine Litter cluster. Also, no information available regarding the interconnections with the Coast and Hydrography cluster.

Contracting Party	**IMAP CI**	**Proposed in National Pollution and ML IMAP**	**Temporal scales**	**Spatial scales**
Tunisia	CI13	NO, not all parameters covered	seasonal	Good spatial integration for EO5, EO9, EO10 no information for EO1, EO7, EO8
	CI14	YES, All parameters	seasonal	
	CI17	NO, not all parameters in all matrices	sediments biannually, biota annually (bivalves; *Mullus barbatus*;	

			Sardina pilchardus)	
	CI18	YES, for SML, AchE, micronuclei (*Ruditapes decussatus and Mullus barbatus)*	annually	
	CI19	YES	no information provided	
	CI20	YES	*not applicable*	
	CI21	YES	bathing season, according to IMAP guidance factsheets	
	CI22	YES	seasonal	
	CI23	YES for Floating microplastics; seafloor macro-litter	annual	
	CI24	NO		

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

30. Despite the good spatial coverage in most cases, and the initial specification of the monitoring areas, these are provided in very preliminary GIS layers within the new IMAPs, whilst in some cases even preliminary GIS layers were not prepared. In addition, the countries have not defined the areas of assessment considering the areas of monitoring.

b) Monitoring programmes of the Contracting Parties that are EU Member States

31. The EU MSs put great effort into adapting their established pollution monitoring programmes[7] related to Descriptors D5, D9 and D10 of relevance for IMAP EO5, EO9 and EO10 respectively, to the existing non-MSFD policy requirements within ongoing planning of the new monitoring programmes, including the emerging needs related to implementation of MSFD and IMAP. The present analysis relies mainly on the monitoring programmes of EU MSs that were established during the 1st cycle of MSFD implementation[8].

32. A 'programme' and a 'sub-programme' can be distinguished as follows: i) the Programmes are defined around the GES Descriptors, reflecting the different aspects of GES for which the monitoring needs to provide data; ii) the sub-programmes are defined around the practicalities of monitoring, reflecting different data types and ways of collecting these data. WG DIKE discussed a proposal that there should be a 'programme' to address each of the Descriptors, i.e., one for eutrophication, one for contaminants, litter etc. For the biodiversity descriptors (D1, 4, 6) it was recognised that it may be more appropriate to structure reporting in another way, e.g. around seabed and water column habitats, and around birds, mammals, reptiles, fish and pelagic cephalopods, to reflect the inter-relationships of these descriptors. Each programme can contain a number of sub-programmes, the number varying depending upon the complexity of the Descriptor, the extent that GES has already been achieved, the (extent of) Member State marine waters, the (variety of) associated

[8] These monitoring programmes were available through EIONET hosted by the European Environment Agency. Given some EU MSs missed the 2014 reporting deadline and therefore present document also relies on information available in relevant EU or national projects (e.g. ACTIONMED, MEDCIS, MEDREGRION, etc.). Also, there was a delay with submission of updated monitoring programmes by some countries (due in October 2020) for the 2nd cycle of MSFD implementation (2018-2024) and therefore it was not possible to take them into consideration within present analysis.

activities, pressures and measures and the environmental targets which have been set. An example structure for a programme and its component sub-programmes is shown here-below in Figure 1 :

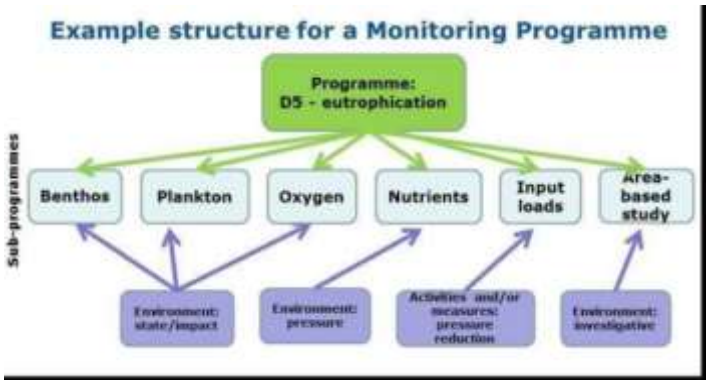


Figure 1. Example of the structure for monitoring programme for a particular descriptor related to the Pollution-ML cluster (e.g. D5(EO5) - eutrophication), with an illustrative set of sub-programmes directed towards monitoring aspects of state/impact, pressures, activities and measures and, if appropriate, investigative studies.

33. A comparison of the national MSFD monitoring programmes with IMAP requirements contributes to further synchronization of the policies, good practices and the innovative monitoring standards related to MSFD and IMAP implementation. Ultimately, this needs to result in development of cost-effective and accurate monitoring programme with similar environmental objectives and geographical scales. To that effect the following key findings are presented below:

i) MSFD monitoring programmes are structured according to the MSFD Descriptors, reflecting the different aspects of GES that need to be monitored, and therefore which data need to be generated for GES assessment. Each programme contains one or more subprogrammes structured around implementation of the monitoring efforts in relevant regions/sub-regions/sub-areas/sub-divisions, reflecting different data types and data collection methodologies.

ii) Overall national monitoring programmes for D5, D9 and D10 show a general consistency, since all of them have been elaborated considering the same principles stated in the MSFD and subsequent guidance documents. It can also be concluded that there is a good match between the descriptors, criteria and indicators and the Common Indicators of IMAP that should prevent duplication of monitoring efforts. However, it could be more useful if all the EU MSs` MSFD monitoring programmes explicitly refer to the Common Indicators of IMAP by providing their interrelation with the MSFD Descriptors in each sub-programme.

iii) However, the monitoring efforts related to D5, D9 and D10 are heterogeneous regarding the percentage of the subprograms addressing each descriptor. To overcome this heterogeneity, a common list of elements to be monitored and the correspondent indicators should be agreed at the regional level, to ensure the feasibility of a regional GES assessment. To that effect IMAP of UNEP/MAP should be considered as the key framework for harmonization of national monitoring programmes.

iv) Regarding the areas of assessment defined within MSFD national/regional plans, it should be noted that the Commission Decision (EU) 2017/848 sets out the criteria and methodological standards to be used for assessing the extent to which Good Environmental Status (GES) is being achieved for the MSFD. The regions and subregions are specified in MSFD Article 4 of which a map was agreed by the MSFD Common Implementation Strategy (CIS) based on the definition of a marine region in MSFD Article 3(2), which states that they are ‘determined taking into account hydrological, oceanographic and biogeographic features’. MSFD Article 4 also recognizes a need for defining the subdivisions to consider the specificities of a particular area to support implementation of the Directive. Following the 2012 reporting, discussions on assessment scales and areas within the MSFD CIS, particularly in the framework of the Working Group on Good Environmental Status (WG GES), have focused on a need for more coherent approach. This led to inclusion of the assessment scales in the 2017 GES Decision and progress towards more consistent approaches, including the coordinated systems used for HELCOM’s HOLAS II and OSPAR’s Intermediate Assessment 2017. Furthermore,

it should be mentioned that the NEAT tool is a further development of the HOLAS tool, as a structured, hierarchical tool for making marine status assessments (Berg et al., 2017; Borja et al., 2016), as explained in section 5.

v) In line with above, all Mediterranean EU MSs have defined their Marine Reporting Units (MRUs), since reporting on Articles 8, 9 and 10 always needs to be linked to a specific Marine Reporting Unit, thereby linking the reported information to a specified part of each MS marine waters. The MRUs can be of varying sizes, as indicated in the new GES Decision, by the scales of assessment to be used. More details on presently defined MRUs, as well as spatial assessment units recognized within implementation of different projects is provided in Chapter 3 herein.[9]

34. Detailed analysis of national IMAP monitoring plans has showed the following commonalities and differences per CI:

- All EU MSs had a long experience regarding monitoring of EO5 and EO9 due to the implementation also of WFD and other relevant pollution Directives (as the Nitrate and UWWT) and obligations under national laws.
- For D5/EO5 CI13 (nutrients), CI14 (chlorophyll), all mandatory IMAP parameters are monitored by EU MSs. Some differentiations exist among MSs, as temperature and hydrodynamics are monitored for EO5 by all MSs except Spain, France and Greece that are monitoring pH and CO_2; phytoplankton communities are monitored by all MSs; angiosperms, macroalgae, and benthic invertebrates are monitored by all MSs except France, whereas France, Italy and Malta are also using nitrogen and phosphorous organic enrichment. Temporal scales are not harmonized among countries ranging from weekly to monthly/bimonthly for parameters as nutrients or chlorophyll *a* to yearly as needed (for example for benthic parameters).
- For D9/EO9, CI 17 all mandatory IMAP parameters are covered in sediments and biota. Temporal scales (such as the reported sampling frequencies) are not harmonized for all countries.
- For CI18 only France fully implemented it. Most MSs are monitoring the effect on mussels. Temporal scales are not fully harmonized, however more usually sampling is annual.
- For CI19, there are no monitoring programmes, but all countries follow the recommendations by REMPEC/MARPOL.
- For CI20 EU MSs are monitoring contaminants in seafood and fish. However, species and temporal scales are not homogenized.
- For CI21 all EU MSs are monitoring pathogens (as enterococci) regularly during the bathing period according to Bathing Water Directive (2006/7/EC).
- For CI22 monitoring programmes exist for all EU MSs. Information was only lacking for Slovenia. Sampling on beaches has been sufficiently tested and has therefore been implemented with a high level of maturity for more than a decade. The main gaps in information were in reference to the spatial resolution, since the spatial resolution in 50% of the beaches was not defined. The resolution of the survey sampling frequency varied from quarterly (38%) to yearly (25%).
- For CI23 EU MSs had seabed monitoring sub-programmes, and six MSs monitored sea surface (except Cyprus and Malta). Information was only lacking for Slovenia. The spatial resolution included some general specifications, e.g. samples which were referenced to the surveys, e.g. MEDITS. The resolution of the sampling frequency of surveys was variable, but the mostly used sampling frequency was the yearly (56%).
- CI24 was monitored in all EU MSs, however this monitoring is considered under development. Information was lacking for Slovenia, which mentions the DeFishGear project to address these gaps by 2020.
- Overall, the spatial coverage of monitoring stations, is well designed allowing for full integration between D5/EO5 and D9/EO9 and very good integration with D10/EO10. EO5 and EO9 have good integration also with D1/EO1, D4/EO4, D7/EO7, as expected, since the data from each one could complement monitoring of the others representing in particular the links between Pressure – Impact – State. Therefore, most countries implement the monitoring of most indicators of the above Descriptors/Ecological Objectives within the same or interlinked programmes/subprogrammes, in a cost-effective way, mainly operating in the frame of the same sampling stations network within each

[9] EcAp Common Indicators CI17, CI18, CI19 are related mostly to criteria of MSFD Descriptor 8 and in more details to D8C1, D8C2 and D8C3/D8C4 respectively, whereas CI20 is related to criterion D9C1 and CI21 to the Regulation 1881/2006.

assessment area and especially in the coastal areas, where most of the anthropogenic effects are located. For example, eutrophication monitoring (D5/EO5) is performed jointly with the monitoring of D1/EO1-plankton and D7/EO7. In addition, mainly due to cost-effectiveness, most of stations for D5/EO5 are used for D9/EO9 as well (see also Tables 3, 4, 5 herein for more detailed information on such interconnections).

35. Detailed analysis of national MSFD/IMAP monitoring plans has showed the degree of requirements adoption and /or their implementation in all contracting CPs being EU MSs. The main gaps have also been identified. The analysis is based on the monitoring programmes available through EIONET hosted by the European Environment Agency. Given some EU MSs missed the 2014 reporting deadline, present document also relies on information available in relevant EU or national projects (e.g. ACTIONMED, MEDCIS, MEDREGRION, etc.), as well as the Reports (2015-2018) on "Article 12 Technical Assessment of the MSFD 2014 reporting on monitoring programmes" prepared by a consortium led by Milieu Ltd, on behalf of DG ENV (under Contract No 07.020100/2014/690611/SER/ENV.C2). Here-below tabular forms are prepared per each country to present the degree of compliance of the specific National IMAP Pollution Cluster Plan with MSFD/IMAP requirements (i.e. green color - full co Croatia has defined six separate sub-assessment areas, with three covering coastal waters and three open waters. Croatia has defined its entire marine waters in the Adriatic as the overall assessment area. mpliance; orange -partial compliance; red - low compliance).

36. **Croatia**: According to the Croatia MSFD monitoring programme submitted to EU has defined six separate sub-assessment areas, with three of them covering coastal waters and three open waters. Croatia has defined its entire marine waters in the Adriatic as the overall assessment area (all in Subregion: Adriatic Sea (ADR), subdivision Middle Adriatic (MADR), assessment area: MADRHR). The MSs' reporting consists of one monitoring programme for all Descriptors and 13 monitoring sub-programmes for EO5 (D5), EO9 (D9) and EO10 (D10). Regarding the monitoring programme for D5 partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets is ensured, since most of the elements and parameters monitored cover eutrophication pressures and both direct and indirect impacts, but does not address directly changes in submerged plant community's health. However, Croatia clarified that seagrass and macroalgae, as well as structure and function of coralligenous assemblages and zoobenthos community status is also monitored through monitoring programmes under D1 (biodiversity) and D6 (sea bed integrity). The monitoring programme for D5 consists of 6 sub-programmes and a 3-monthly frequency of monitoring is adequate for most of the parameters. Regarding spatial scope and coverage, the eutrophication parameters are measured in the central and south Adriatic at selected stations, in coastal areas which are under increased anthropogenic load, or as where 'natural eutrophication' is considered to be an important pressure. Therefore, the spatial coverage appears appropriate and risk-based, with monitoring sites chosen primarily according to pressures, and primarily in coastal waters. Finally, it must be noted that for D5 the Croatian monitoring program builds on that of WFD. As such it covers most of the parameters under CIs 13 and 14 of IMAP EO5.

37. The MSFD monitoring programme of Croatia is ensuring coverage of the monitoring needs for the assessment of progress towards GES and targets related also to EO9 and by being linked also to Regulation 1881/2006 (and its associated amendments)[10]. Croatia reported one programme with 3 sub-programmes focusing on monitoring of cadmium, mercury and lead, dioxins, dioxin-like PCBs and PCBs, as well as biotoxins (ASP, DSP, dPSP) and PAHs and radionuclides. Spatial scope and coverage of the sub-programmes has not been reported by the MS and thus cannot be assessed. In terms of the frequency of the monitoring of biota it is annual in all three sub-programmes for metals, dioxins/PCBs and radionuclides.

38. The Croatian monitoring programme is adequate for Descriptor 10, which relates to EO10. However, the MSFD criteria that Croatia implements is related to CIs 23 & 24 and not to CI22. In more details the ML programme consists of 4 sub-programmes and ensures partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets. The elements monitored are seabed habitats, water column, micro-particles and litter in animal stomachs (CI23, CI24). The elements that are not monitored are beach litter (CI22) and the impact of litter on human health. Furthermore, there is not enough information reported by this MS to assess the adequacy of the spatial coverage. There is a limited number of human activities indicated as relevant to the monitored elements under EO5, EO9, EO10, which are fisheries, aquaculture, tourism and recreation, research surveys and shipping.

[10] UNEP/MAP (2011). UNEP(DEPI)/MED WG.363/Inf.21. UNEP/MAP 2011 Initial Integrated Assessment

39. In the monitoring report of Croatia, reference is made to Barcelona Convention and WFD, as the Croatian monitoring activities are in line with IMAP and WFD.

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML - MSFD/IMAP**	**Temporal scales**	**Spatial scales**
Croatia	CI13	YES, all parameters	every 3 months	Not adequate information regarding spatial coverage, however a partial spatial integration for EO5, EO9, EO10 can be concluded, as well a good spatial integration with EO1, EO7 and EO8
	CI14	YES, all parameters except pH	every 3 months	
	CI17	YES all parameters	annually	
	CI18	YES, all parameters	annually	
	CI19	YES, all parameters	annually	
	CI20	YES, all parameters	annually	
	CI21	YES, all parameters	bathing period	
	CI22	NO		
	CI23	YES, all parameters	every 3 months	
	CI24	YES, all parameters except ML impact in human health	every 3 months	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

40. **Cyprus**: The MS`s marine waters are in Eastern Mediterannean Sea (Levantine) and all MSFD monitoring is realized in the Aegean-Levantine Subregion (MAL), assessment area: MALC. D5 and D9 monitoring prrogrammes relevant to IMAP EO5 and EO9 will most likely ensure coverage of the monitoring needs for the assessment of progress towards the achievement of GES and partial coverage regarding targets, whereas D10 (EO10) ensures partial coverage for GES. Regarding D5 one sub-programme has been reported which covers all GES criteria and indicators for MSFD and thus including CI13, CI14 for IMAP. However, Cyprus has not reported the monitoring frequency for D5, in terms of spatial scope and coverage. It appears that its target/GES thresholds will apply to all Cypriot sovereign waters, but monitoring will only be undertaken in WFD coastal waters, which is a gap.

41. In relation to EO9, CI17 to CI20 are covered in combination of D8 and D9 MSFD monitoring programmes . For D8 three sub-programmes have been reported: Contaminants in sediments (relevant to CI17), Contaminants in biota (relevant to CI17), Spills and illegal discharges (relevant CI19). For D9 one sub-programme was reported, where the MS selected fish species (*Mullus sp., Boops boops, Thunnus alalunga, Xiphias gladius*) to monitor towards GES achievement and the monitored elements are PCBs, PAHs, Lead, Cadmium, Mercury and ^{137}Cs, ^{40}K, thus relating to CI20. Cyprus reported that spatial coverage is 100% i.e. coastal waters (WFD), territorial waters, and EEZ. Monitoring is annual. As shown above, the monitoring programme has links to IMAP Pollution Cluster monitoring, whereas the national radionuclides monitoring is relevant to the context of the IAEA. The contaminants-in-seafood programme addresses in whole or in part the indicators of Ecological Objective 09 adopted by the Contracting Parties of UNEP/MAP (2013). Cyprus

reports that it has coordinated the development of its GES (and associated indicators) with UNEP-MAP Mediterranean Ecological Objectives. Cyprus has selected four fish species to monitor their progress towards achieving GES in three bays on the south coast. Monitoring is annual which is comparable to the OSPAR and HELCOM approach and should be adequate. However, the monitoring should cover all seafood for consumption and therefore not only monitor fish caught locally. The density of sampling is defined "as needed."

42. As far as D10 relevant to EO10 is concerned 3 sub-programmes were reported related to beach litter (CI22), seabed litter (CI23) and mobile species mortality from ML (CI24). By monitoring beach litter, seabed litter and stranded sea turtles, the monitoring programme mostly ensures the coverage of its GES definition. Beach litter is monitored every 6 months and seabed litter annually. The stranded Caretta caretta sea turtles are monitored as need be. Beach litter is monitored on selected tourist beaches and on remote beaches. With the proposed programme, micro-particles monitoring has not been covered, but the MS monitors seabed litter, even though this is not part of its GES definition. Regional cooperation is always referred to all programmes, in the sense that the MS has taken up UNEP-MAP recommendations and is committed to the RSC process in the design of its MSFD programmes as a whole.

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML - MSFD/IMAP**	**Temporal scales**	**Spatial scales**
Cyprus	CI13	YES, all parameters	seasonal to annual	Assumed adequate spatial integration for EO5, EO9, EO10. There is a partial integration with EO7, EO8, EO1.
	CI14	YES, all parameters	seasonal to annual	
	CI17	YES all parameters	annual	
	CI18	YES all parameters	as needed	
	CI19	YES	as needed	
	CI20	YES all parameters	as needed	
	CI21	Not adequate information to assess	bathing period	
	CI22	YES all parameters	every 6 months	
	CI23	Only seabed ML	annual	
	CI24	YES	as needed	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

43. **France**: The MS is part of two marine regions, the North East Atlantic Ocean and the Mediterranean Sea. In the Mediterranean, the French sub-region is integrated in the marine waters of the sub-region 'Western Mediterranean' (assessment area: MWEFR) as defined in relation to the Ecosystem Approach within the framework of the Barcelona Convention. France noted that, during bilateral exchanges, it appeared that this boundary partially overlaps with the Spanish one. France reported that in its monitoring programme is covering also impact activities as aquaculture, tourism, renewable energy, including W. Mediterranean, The monitoring programme of France for Descriptor 5, relevant to EO5, ensures partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets. All elements and parameters included in the French GES definition are covered by the monitoring programme for Western Mediterranean sub-region with 10 sub-programmes therefore CI13 and CI14 are covered, but there is insufficient information provided on the frequency and spatial coverage.

44. The monitoring programme for Descriptor 9, relevant to EO9, with 3 sub-programmes in Western Mediterranean ensures partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES. France has used a D8 sub-programme (out of the five D8 subprogrammes) to address D9 as well, in addition to the phycotoxin and microbial contamination that it monitors through the two D9 specific sub-programmes per sub-region (18 stations), which however might not be adequate for D9 regarding species or tissues, therefore also for IMAP EO9. Also, France makes no reference to Environmental Quality Standards (EQS) by citing either the EQS directive (EQSD) 2008/105/EC or the updated version 2013/39/EU or to Regulation 1881/2006 in its monitoring programme. Instead it refers to the French food safety monitoring and control plans, which supports implementation of the national Law on food safety, based on the

EU legislation. Through the D8 monitoring programme France covers perfluorinated compounds, dicofol, dioxins, trace metal elements (Cd, Hg, Pb), PAHs, HBCDD, heptachlor, organotins, PBDEs, PCBs, PCDD, PCDF in water, sediments and biota; PAHs, metals, organotins, PBDEs, PCBs; in shellfish (mussels and oysters) and fish; alkylphenols, aniline, chloroanilines, chlorobenzenes, chlorophenols, PAHs, volatile organic halogen, organotin, pesticides, phenols, persistent organic pollutants (POPs), various semi-volatile organic compounds for inputs from land based sources; and acute pollution events (origin, occurrence, extent). The contaminants being monitored are all relevant to Regulation 1881/2006, but the species and tissues that are monitored within D8 may not be fully relevant or sufficient to adequately address D9 (respectively CI 20). Namely, this MS does not specify which species are monitored through this monitoring programmes, in order to assess if adequately covers biota matrix relevant to D8 elements and seafood relevant to D9. It can be concluded that CIs 17, 18, 19, 20 and 21 are covered through D8 monitoring programme, while for ASP, DSP, PSP lipophilic toxins and microbial contamination in bathing water and shellfish are covered within D9, as mentioned above, in Western Mediterranean. Overall, in Western Mediterranean sub-regions D8 sub-programmes cover concentrations of chemical/pollutant in biota; while D9 sub-programme covers quantity and type of microbial pathogens and biotoxins.

45. The monitoring programme with 5 sub-programmes for Descriptor 10, relevant to EO10, ensures coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets. The sub-programmes reported for Western Mediterranean sub-division cover beach litter (CI22), seabed litter (CI23), floating litter (CI23), microparticles, as well as waste ingested by marine mammals and sea turtles (CI24) covering ecological impact of marine litter, impacts of chemicals on the ecosystem, pathogens (national food safety monitoring) and by-catch.

46. At the regional and sub-regional level, France refers besides WFD, UWWTD, Nitrates Directive, Bathing Water Directive, also to the strong links with UNEP-MAP for its sub-programmes for W. Mediterranean, which work is relevant to UNEP-MAP context.

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML - MSFD/IMAP**	**Temporal scales**	**Spatial scales**
France	CI13	YES, All parameters	not defined	Good spatial integration for EO5, EO9, EO10. Partial integration with EO7, EO8, EO1. Specifically, EO5, EO7, EO8 are linked to the WFD monitoring as well, but due to limited infromation provided, an integration cannot be fully assessed.
	CI14	YEs, All parameters	not defined	
	CI17	YES, All parameters	annually	
	CI18	YES, All parameters	annually	
	CI19	YES	as needed	
	CI20	YES	annually	
	CI21	Not defined adequately	not adequate infromation available, probably monthly during bathing period or as needed.	
	CI22	YES, All parameters	annually	
	CI23	YES, All parameters	nnually	
	CI24	YES	Continuous	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

47. **Greece:** The MS submitted to EU in 2017 its MSFD monitoring plan. Greece's approach is mainly to use the existing sampling points from different monitoring schemes to collect and integrate data to fulfil MSFD reporting obligations. Greek marine waters fall within one marine region, the Mediterranean Sea, and three marine subregions, the Adriatic Sea, the Ionian Sea and Central Mediterranean Sea, and the Aegean-Levantine Sea. No formal updated subdivision has been identified. In 2012 Greece submitted 6 assessment areas (MRUs), one in Adriatic Sea (MAD-EL-MS-AD), one in Ionian Sea and Central Mediterranean Sea (MIC-EL-MS-IO) and 4 in Aegean-Levantine Sea: Levantine Sea (MAL-EL-AA-LE), 3 in Aegean Sea which are South Aegean Sea (MAL-EL-AA-SA), Central Aegean Sea (MAL-EL-AA-CA), and North Aegean Sea (MAL-EL-AA-NA). Descriptors may be simultaneously monitored by more than in one network, thus widening the spatial scope and frequency of monitoring. The D5 monitoring programme (3 sub-programmes), relevant to IMAP EO5, is addressing both CI13 and CI14, though is likely to partially cover the monitoring needs for the assessment of progress towards the achievement of GES and targets, mainly in relation to spatial (regarding offshore stations) and temporal coverage. There is a risk for the indicators and the frequency of the monitoring programme not to provide an accurate description of the pressures and assessment towards the achievement of the targets, because the targets are related to reducing organic and nutrient loads to the sea and the indicators are focused on measuring the impact of eutrophication. Nutrient-related indicators provide more direct information on the status of eutrophication. The spatial coverage is adequate, with greater resolution in coastal waters than in open seas, with over 70 sampling locations in total. The monitoring frequency is reported as 'at least' twice per year for most of the MSFD and WFD sampling sites. This is sufficient for most of GES indicators, but scarce for Secchi depth or phytoplankton variables and may lead to misclassification. Therefore, the current minimum sampling frequencies may require combining results from different locations to assess GES as from other national monitoring frameworks.

48. Greece provided insufficient information to assess the monitoring programme for D9 relevant to IMAP EO9 to measure progress towards the achievement of GES and targets, however it can be compensated by the D8 monitoring, therefore they must be assessed together. The D8 relevant to IMAP EO8 monitoring programme is also linked to the existing broad network of the WFD, and it is also actively committed to the principles of the Barcelona Convention. The monitoring programme does not target any particular activity that may impact the elements and parameters monitored for both D8 and D9. Greece monitors PAHs, PCBs, DDTs, Drins, TBTs, Cd, Pb, Cu, Ni, Zn, Hg, Fe, Mn in sediments, water and biota –fish and mussels (CI17, CI18). Greece's monitoring programme report refers to D9 as 'Bioaccumulation', covering "Frequency of levels exceeding regulatory levels in fish and seafood" (CI20). Also Greece is monitoring CI19, as need be. Spatial coverage for D9 is not detailed but, as monitoring is stated to be done by competent public health authorities, it is expected that samples are collected throughout the entire territory of Greece. Mussels are mentioned as being monitored (used as bio-indicator for D8 (EO9 – CI17)), as well as fishes (*Boops boops*, *Mullus sp*., etc). Not conclusive information is given for CI21, however is monitored during the bathing period regularly, in relation to the Bathing Waters Directive.

49. The monitoring programme for D10 relevant to EO10, is covering at least partially the monitoring needs for the assessment of progress towards GES and targets with 4 subprogrammes related to ML on the coast (CI22) where are monitored the number of items per kilometer of sampling and their composition: density and composition (plastic, derelict fishing gear, metal, glass, clinker) of litter washed ashore and/or deposited on coastlines; ML in the water column (CI23), floating micro-plastics will be carried out, in the DCF network (Common Fisheries Policy-Data Collection Framework); on the seafloor (CI23), where are monitored the number of items per square kilometer and their composition, the monitoring of the litter density and composition (plastic, derelict fishing gear, metal, glass, clinker) on the sea floor in the Greek Seas is using the data collected in the DCF network, moreover the litter density and composition (plastic, derelict fishing gear, metal, glass, clinker) of the litter accumulated due to hydrodynamics in canyons descending from the continental slope and in the bathyal plain (depths more than 500 m) will be carried out in one representative site every six years; and on biota (quantity and quality of micro-plastics in fish through CFP-DCF) (CI24). Uncertainties exist regarding some aspects of spatial coverage and frequency of the monitoring. The monitoring programme for D10 is mainly built on a specific monitoring exercise for the sub-programme on

the marine litter on the coast relevant to CI20 (at least six beaches near major cities or touristic areas are monitored), and on data from the DCF network for the other three sub-programmes. Although most aspects are covered, yet monitoring the mortality of marine organisms caused by marine litter relevant to CI24 (e.g. by ingestion or entanglement) presents some uncertainties, however marine animal deaths caused by ML are monitored.

50. Finally, regional cooperation is a central concern for Greece – it has taken on the UNEP/MAP recommendations and shows commitment to the Regional Sea Convention (RSC) process in the design of its MSFD programmes. Moreover, Greece relies also to WFD, UWWTD, Nitrates Directive, Habitat Directive and CFP - DCF (Common Fisheries Policy-Data Collection Framework).

Contracting Party/EU MS	IMAP CI	Proposed in National Pollution and ML - MSFD/IMAP	Temporal scales	Spatial scales
Greece	CI13	YES, all parameters	2 times to seasonal per year	Good spatial integration for EO5, EO9, EO10 . Good spatial integration of EO5 and EO9 with EO7, EO8 and elements of EO1. .
	CI14	YES, all parameters	2 times to seasonal per year	
	CI17	YES, all parameters	annual toEvery 2nd year	
	CI18	YES, all parameters	annual to every 2nd year	
	CI19	YES, all parameters	as needed	
	CI20	YES, all parameters	annual to Every 2nd year	
	CI21	YES, pathogens in water, but not concrete information is provided	bathing period	
	CI22	YES, all parameters	seasonal	
	CI23	YES, all parameters	seasonal	
	CI24	YES, all parameters	as need be	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

51. **Italy:** Italy's marine waters are part of the marine region of the Mediterranean Sea and cover the sub-divisions of the Adriatic Sea, the Ionian Sea and the Central Mediterranean Sea and the Western Mediterranean Sea. The monitoring programme for Descriptor 5 (2 programmes and 8 sub-programmes) is built on the monitoring for the Urban Wastewater Treatment Directive and the Water Framework Directive and ensures s partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets. The monitoring covers nutrients (CI13), but insufficient information was found regarding Chlorophyll *a* levels (CI14) and phytoplankton community composition and abundance within D5 sub-programmes. Therefore, they are covered by other subprogrammes under D1, D4. However, it must be mentioned that existing targets to be addressed by the sub-programmes include diffuse nutrient loading to the

marine environment via rivers, and nutrients and chlorophyll *a* levels in marine rivers. Also, little information is provided on the elements/parameters to be monitored or on the spatial coverage and monitoring frequencies. The monitoring programme for Descriptor 8 with relevance to EO9 needs includes hazardous substances monitoring in water, sediments and biota (CI17, CI18) and the programme for D9, relevant to EO9 also,includes the hazardous substances in seafood and fishes (CI20). The programme for D8 is able to cover partially the monitoring needs for the assessment of progress towards the achievement of GES and targets, since it is addressing levels of hazardous substances and effects, as well the pressures. There is compliance with the WFD and the EQSD standards (Environmental Quality Standards directive (EQSD) 2008/105/EC or the updated EQSD (2013/39/EU), and the use of appropriate assessment methods. In relation to the above, the monitoring programme for Descriptors 8 and 9 covers partially the monitoring needs for the assessment of progress towards the achievement of GES and targets, based on the implementation of Regulation 1881/2006. Italy, though does not list specific contaminants, however it states that for monitoring water, sediment and biota the parameters that are measured are: concentration of contaminants belonging to the priority list and all those for which a value has been identified by the Environmental Quality Standard in at least one marine matrix. However, Italy provides data for the analysis of samples of fish, crustaceans, molluscs, echinoderms, fish eggs and algae for human consumption with known geographical origin.

52. The monitoring programme for Descriptor 10, relevant to EO10, covers the monitoring needs for the assessment of progress towards the achievement of GES and targets. The 4 sub-programmes monitor for beach litter (CI22), seabed litter (CI23), micro-particles and the impact of marine litter on biota (CI24), in particular Caretta caretta sea turtles. Annual monitoring is proposed for micro-plastics, beach litter and seabed litter. Sea turtles found dead on the beach are monitored for the impact of marine litter on biota where needed. Micro-plastics are monitored up to 12 NM. Beach litter monitoring is divided into port/urban areas and remote areas. Seafloor litter is monitored for the geographical sub-areas defined by Food and Agricultural Organisation (FAO) in Italian seas.

53. The Italian monitoring programmes are using existing European and regional monitoring requirements, as part of various European Directives such as the CFP, WFD, Habitats Directive, Urban Waste Water Treatment Directive and others. At the regional level, UNEP/MAP monitoring programmes form the basis of many monitoring programmes of the MSFD as for contaminants' pollutions. The assessment of transboundary impacts and features are also tackled in the context of regional cooperation through UNEP/MAP. Italy has made links with the activities it undertakes in the framework of UNEP/MAP.

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML - MSFD/IMAP**	**Temporal scales**	**Spatial scales**
Seasonal to annually as needed	CI13	All parameters	every 2 months to annually	Good spatial integration for EO5, EO9, EO10
	CI14	All parameters except pH	every 2 months to annually	
	CI17	All parameters	water at least seasonal, sediment and biota at least annual	
	CI18	YES all parameters	at least annual, as needed	
	CI19	Not adequate information	not adequate infromation	
	CI20	YES, all parameters	seasonal to annually as needed	
	CI21	YES	bathing period	
	CI22	YES	annually	
	CI23	YES	annually	

	CI24	YES	as needed	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

54. **Malta**: The Maltese Islands are part of the Mediterranean region and specifically the Ionian Sea and the Central Mediterranean Sea sub-region (MICMT). Malta reported that monitoring programme for Descriptor 5, relevant to IMAP EO5, covers all the criteria and indicators of Commission Decision 2010/477/EU with 5 five sub-programmes, as well as CI13 and CI14 for IMAP, which ensure coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets for both EcAp and MSFD. Also, the reported spatial coverage and the monitoring frequencies are adequate, especially considering the small size and short coastline of Malta. The choice of monitoring sites covers areas which are expected to be subject to high and low levels of land-derived pressures, both hard and soft-bottom habitats and different water types. The frequency of the monitoring of Chlorophyll-a, Secchi depth and turbidity is monthly for coastal monitoring stations and every 6 months for offshore stations, which is considered appropriate.

55. To address the CIs 17 to 20, both monitoring programmes for MSFD Descriptor 8 and Descriptor 9 must be considered. D8 has four sub-programmes, which ensure partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets, by assessing contaminants in the three relevant environmental matrices: water, sediment and biota (CI17) and apply the latest EQS standards as defined in Directive 2013/39/EU. Concerning acute pollution events (CI19), the monitoring registers these events but does not currently investigate its environmental impacts. The monitoring programme for Descriptor 9 with a single sub-programme: contaminants in seafood, related to CI20 (based in D8 also) covers the monitoring needs for the assessment of progress towards the achievement of GES, whilst the targets were not defined. The Maltese monitoring programme has been linked to Regulation 1881/2006 and its associated amendments. Therefore, it covers the necessary elements and parameters to be monitored. Malta's monitoring is focused on fish caught within its own waters and for pelagic fish which is consumed nationally. Heavy metals (Pb, Cd, Hg) are sampled in large pelagic (Thunnus thynnus, Xiphias gladius and Coryphaena hippurus) caught in Malta and consumed by the Maltese population. Levels of selected contaminants (i.e., Pb, Cd, Hg, PAHs, dioxins and non-dioxin like PCBs) are measured in specimens of fish (Mullus barbatus/Merluccius merluccius) and crustacea (Parapenaeus longirostris/Aristaeomorpha foliacea) sampled within or in the vicinity of catch areas (CI20). The temporal scale of the monitoring is reported as 2 yearly for the sampling of retail samples (e.g. Thunnus thynnus) and yearly for fish caught as part of MEDITS (e.g. Mullus barbatus).

56. The monitoring programme for Descriptor 10, relevant to IMAP EO10, partially covers the monitoring needs for the assessment of progress towards the achievement of GES and targets, having 5 sub-programmes. The elements monitored are beach litter (CI22), litter in the water column and on the seabed (CI23) and the entanglement of mobile species in marine litter (CI24), as Caretta caretta, the indicator species to monitor ingested marine litter and entanglement in fishing nets. Also beach cleaning activities are monitored and the maritime garbage received at port reception facilities. Malta reports that there are gaps in its monitoring programme. Furthermore, the MS reported that the monitoring programme is to be extended to include sub-programmes on micro-litter and the entanglement/ingestion of litter by marine life by 2020. The targets proposed under the Barcelona Convention, adopted by Malta to address beach litter, litter in the water column and on the seafloor, are all monitored. In terms of frequency of the reported monitoring, beach litter is monitored with a 3-monthly frequency on two recreational and two remote beaches. Litter in the water column is monitored 6-monthly for four locations. Litter on the seabed is monitored yearly by means of 40m line transects. Two monitoring methods are proposed depending on the depth of the seabed. If the depth is less than 20m, seabed litter will be collected by scuba divers. In the areas with depth between 20m and 800m, seabed is monitored by trawling surveys following the protocol for monitoring marine litter on a voluntary basis, as in MEDITS. Finally, regarding entanglement of species, the number of dead or stranded loggerhead turtles Caretta caretta, with signs of entanglement of marine litter are recorded.

57. The most common links made in the monitoring programmes are with EU legislations as the Directive 2000/59/EC on port reception facilities for ship-generated waste, the Bathing Water Directive and the Blue

Flag Programme, the Common Fisheries Policy (CFP), WFD, MARPOL Convention and UNEP/MAP standards and monitoring activities.

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML - MSFD/IMAP**	Temporal scales	Spatial scales
Malta	CI13	Yes, all parameters	monthly in coastal areas, every 6 months in offshore areas	Good spatial integration for EO5, EO9, EO10. Good spatial integration of EO5 with EO7, EO1
	CI14	Yes, all parameters	monthly in coastal areas, every 6 months in offshore aras	
	CI17	Yes, all parameters	1-2 times annually	
	CI18	Not available information	not available information	
	CI19	YES, all parameters	As need be	
	CI20	YES, all parameters	1-2 times annually	
	CI21	Not available information	not available information	
	CI22	YES, all parameters	beach ML every 3 months,	
	CI23	YES, all parameters	Water ML Every 6 months, Seabed ML once annually	
	CI24	YES	as needed	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

58. **Slovenia**: The MS` marine waters are part of the marine sub-region of the Adriatic Sea (MAD). No more formal subdivisions were found. The monitoring programme for Descriptor 5 (one subprogramme) relevant to IMAP EO5 establishes a partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets. The monitoring programme however, does not provide further details on spatial resolution, even though spatial coverage appears to be adequate, however information on sampling frequency is stated as annual within a 6 years cycle for phytoplankton, though phytoplankton parameters need to be more frequently monitored as monthly or every 15 days during the growing season. According to Slovenia, the monitoring programme for D5 was going to be adequate only by 2020; namely, the MSs had to submit the updated monitoring plans during 2020. The monitoring undertaken for D5 includes species abundance (biomass), concentration of chlorophyll *a* (CI14), concentration of oxygen, transparency /turbidity of water column and concentration of chemical/nutrient (CI13)/pollutant in the water column. The monitoring programme covers coastal water (WFD) and territorial waters, thus covering 100% of the national waters, and therefore it is assumed to be appropriate; though no specific information is provided on spatial coverage (resolution).

59. The monitoring programme for Descriptor 8 (1 subprogramme) relevant to IMAP EO9 common indicators, covers partially the monitoring needs for achievement of GES and targets. It is focused on

contaminants in water, sediment and biota (CI17). The effects of contaminants are not monitored (CI18), nor are the pressure input parameters. Slovenia stated that it will harmonize the assessment criteria with those of UNEP/MAP and expects an adequate coverage by 2020. The reported information is insufficient to assess whether the density of sampling is adequate. In addition, acute pollution events, are not monitored (CI19). Furthermore, Slovenia has not established monitoring (sub-) programmes for D9/EO9, so CI20 is not monitored.

60. The programme for Descriptor 10, relevant to IMAP EO10 on marine litter consists of one sub-programme ensuring partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets. Currently, beach litter is monitored, but there are gaps related to other important components of the GES definition such as the impacts of marine litter on marine life, on seafloor litter, floating litter, micro-particles. Slovenia reports that its monitoring programme should cover its GES definition by 2020 and mentions the DeFishGear project to address these gaps by 2020, which is covering the missing parameters. Slovenia has identified marine fisheries and mariculture, maritime transport, tourism and coastal settlements as activities affecting marine litter in the country.

61. Overall, most common links made in the monitoring programmes of Slovenia are with EU legislations, as WFD, Nitrates Directive, Bathing Water Directive, with Common Fisheries Policy (CFP) and UNEP/MAP standards and monitoring activities (especially for EO5 and EO8).

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML - MSFD/IMAP**	**Temporal scales**	**Spatial scales**
Slovenia	CI13	YES, Most parameters	not adequate information	Assumed adequate for EO5. Partial spatial integration for EO5, EO9, EO10. Not adequate information are available to conclude regarding integration with other EOs.
	CI14	Yes, All parameters	annually	
	CI17	YES, All parameters	not defined	
	CI18	Not defined	not defined	
	CI19	Not defined	not defined	
	CI20	Not defned	not defined	
	CI21	Not defined	ot defined	
	CI22	YES , only for beach ML	bimonthly	
	CI23	Not defined	not defined	
	CI24	Not defined	not defined	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

62. **Spain**: The MS has 5 marine subdivisions: 3 in Atlantic and 2 in Mediterranean Sea: the Levantine Balearic Sea (LEBA), and Estrecho and Alboran (ESAL). For each subdivision, the MS reports three dedicated monitoring sub-programmes for eutrophication (D5/EO5) and three general pressure monitoring programmes on inputs from land-bases sources and the atmosphere. In addition, one water column sub-programme and one seabed habitats monitoring sub-programme from biodiversity monitoring also contribute to D5, relevant to IMAP EO5. Finally, one activity monitoring sub-programme and one sub-programme describing operational objectives have also been associated with the monitoring programme in each sub-division. The monitoring programme for Descriptor 5/EO5 covers the monitoring needs for the assessment of progress towards the achievement of GES and targets. Most of the elements and parameters included in the Spanish GES definitions are covered by the monitoring programme in an appropriate manner and in accordance with requirements under UNEP-MAP for the Mediterranean regions, thus monitoring of CIs 13

and 14 is performed. Monitoring frequency is reported at least four times a year in open waters in LEBA and ESAL, but monitoring frequency is not stated for coastal waters.

63. For each sub-division, the MS reports five dedicated monitoring sub-programmes for D8, relevant to IMAP EO9 common indicators CI17 and three general pressure monitoring programmes on inputs from land-based sources. In addition, three activity monitoring sub-programme and one sub-programme describing operational objectives have also been associated with the monitoring programme in each sub-division. In all sub-divisions, the monitoring includes contaminants concentrations in sediments and biota (CI17), as well as their effects on bio-indicator organisms in coastal zones (i.e., up to 1 mile off the coastline) (CI18). Spain reports that the monitoring for the two Mediterranean sub-divisions is in line with the Barcelona Convention (UNEP/MAP) CI 17 and CI18 and utilizes the OSPAR guidelines. A wide range of elements are monitored in all sub-divisions for CI17, such as heavy metals (in biota and sediment), PCBs (in biota and sediment), PAHs (in sediment), PBDE (in biota and sediment), organotin (in sediment), organochlorine pesticides (in biota and sediment), HCBD (in biota), imposex (i.e., gastropod male genital length) and metabolites in bile-, as a pilot project (i.e., 1-pirenol concentration per unit weight of fish bile sample). Spain also reports that overall, concentration of priority substances and other pollutants, as defined by the WFD, are monitored in coastal waters. Depending on the sub-division, some variations exist, for example the sub-programme in both Mediterranean sub-divisions monitors organochlorine pesticides in biota, as well as AChE enzyme activity in target tissues of fish or mussels; EROD activity in liver of microsomal fractions of fish and prevalence of intersex (i.e., presence of oocytes) in gonads of male fish (CI18). Also, there is monitoring of the microbial pathogens in bathing waters (CI21) and radionuclides, as well as impacts of acute pollution events (CI19). Contaminant inputs from acute pollution events, such as ship accidents, exploration and exploitation of hydrocarbons, port activities or industrial activities close to shore are monitored. Spain reports that the sub-programme is linked to MARPOL 73/78. The sub-programme covers accidental oil spills from ships and platforms and other discharges that result in the activation of contingency plans against marine pollution. The monitored parameters are the geographic coordinates, the volume of accidental pollutant discharge and the area affected by the pressure or activity. The frequency in the Mediterranean sub-programmes is defined as annual in molluscs, biannual in fish and every 4 years in sediments. Furthermore, the spatial distribution of contaminants in biota and sediments take place every 4-6 years. Radionuclides are monitored quarterly. Pathogens are monitored annually.

64. The monitoring programme for Descriptor 9 “contaminants in seafood” relevant to IMAP EO9 and its CI 20 consists of two dedicated D9 sub-programmes per sub-division. The sub-programme monitors contaminants in tissues of edible fish, crustaceans, molluscs, echinoderms and algae in Spanish waters. The contaminants monitored are Cadmium, Mercury and Lead. Furthermore, Spain lists dioxins (PCDDs / Fs), and polychlorinated biphenyls similar to dioxines (DL-PCBs), non-dioxin-like PCBs (NDL-PCBs) (28, 52, 101, 138, 153 and 180). Also, Polycyclic aromatic hydrocarbons (PAHs), such as benzo (a) pyrene, benzo (a) anthracene, benzo (b) fluoranthene and chrysene. Also, Spain reported to monitor microbial pathogens in organisms such as bivalve molluscs and other fishery products, which are intended for human consumption (CI21). Concluding the monitoring programme for Descriptor 9 /EO9 ensures coverage of the monitoring needs for the assessment of progress towards the achievement of GES and targets.

65. Regarding D10 relevant to IMAP EO10, in each sub-division, seven sub-programmes are directly addressing marine litter; whereas two additional biodiversity sub-programmes, two general pressure sub-programmes, two general activity monitoring sub-programmes and one general operational objectives sub-programme are also reported to have relevance to marine litter. The sub-programmes reported in all sub-divisions cover: beach litter, seabed litter and floating litter (CI22, CI23). The sub-programme on additional data gathers data on both beach litter and seabed litter, based on volunteering initiatives. The monitoring programme for Descriptor 10/EO10 covers partially the monitoring needs for the assessment of progress towards the achievement of GES and targets. All sub-programmes are monitored with an annual frequency, except for the beach litter programme, which has a three-monthly monitoring frequency. A weakness in the reporting is that the spatial and temporal coverage of the seabed litter sub-programmes has not been reported on, and thus cannot be assessed. The monitoring programme for Descriptor 10 ensures partial coverage of the monitoring needs for the assessment of progress towards the achievement of GES Sub-programmes are reported on beach litter, floating litter and seabed litter; in addition to three sub-programmes on micro-particles in the water column, on the seabed and on the beach. One sub-programme is based on volunteering initiatives and provides additional data on beach litter and seabed litter. Spain reports that the sub-programme on the strandings of whales and turtles (MT-5) and seabirds (AV-5) also provide data on the impact of litter on

marine biota. More information is required to assess the extent to which the latter two sub-programmes monitor the impact of marine litter on marine biota, which is part of the Member State's GES definition. Spain has not identified any gaps and hence has not presented any further plans for modifications to the monitoring programme for D10 which it considers adequate by 2014. The Member State does report that improvements are planned by 2020.

66. Links with the Barcelona Convention are reported. Links with other policies are with MARPOL, Common Fisheries Policy (CFP), the Water Framework Directive (WFD), the Habitats Directive, Nitrates, the Urban Waste Water Treatment Directive and others.

Contracting Party/EU MS	**IMAP CI**	**Proposed in National Pollution and ML -MSFD/IMAP**	Temporal scales	Spatial scales
Spain	CI13	Yes, all parameters	at least seasonal in coastal waters, 2-4 times per year in offshore	Good spatial integration for EO5, EO9, EO10
	CI14	Yes, all parameters	at least seasonal by point sampling and continuous by remote sensing	
	CI17	Yes, all parameters	annual to biannual in organisms, every 4 years in sediments	
	CI18	Yes, all parameters	annual to biannual in organisms, every 4 years in sediments	
	CI19	YES, in bathing waters and organisms	as needed	
	CI20	YES	annual	
	CI21	YES	as needed	
	CI22	YES	every 3 months	
	CI23	YES	annual	
	CI24	YES	as needed	

	Full Compliance with IMAP requirements		Partial Compliance with IMAP requirements		Low Compliance with IMAP requirements

3. Defining the scales of assessment

67. In the region of Mediterranean Sea, four main areas (sub-regions) have been established for practical reasons and for the purpose of the UN Environment/MAP 2011 Initial Integrated Assessment11 and the Med QSR 2017 assessment, namely: the Western Mediterranean Sea (including the Alborán Sea characterized by

[11] UNEP/MAP (2016 a). UNEP(DEPI)/MED WG.427/Inf.3. Background to the Assessment Criteria for Hazardous Substances and Biological Markers in the Mediterranean Sea Basin and its Regional Scales these revised assessment criteria

the exchange of the Mediterranean waters with the Atlantic Ocean), the Adriatic Sea (which is a double semi-enclosed area by itself), the Central Mediterranean (acting as the nexus for the eco-regions and located in the center of the basin with a low anthropogenic influence), and the Aegean and Levantine Seas in the Eastern Mediterranean part.

68. The sub-divisions (i.e. subareas/seas) for IMAP Pollution and ML Cluster have been initially identified according to availability of database sources for the purpose of development of the assessment criteria for pollution as provided in Table 1 here-below [12]. Sub-divisions might initially further correspond to the CPs` coastal zones and offshore areas[13]. Other sub-divisions may be defined. This Mediterranean sub-regions and subareas aggregation initially follows the risk-based approach in a nested scheme as follows (see also Fig. 3): (i) coastal waters; (ii) national subdivisions (within national borders); (iii) regional subdivisions; (iv) subregions; (v) Mediterranean Region.

69. The areas of assessment need to be built from the monitoring units by applying nested approach and can be fit-for-purpose according the general or specific objectives to be covered in relation to the environmental threat. Therefore, the analysis of the areas of monitoring is the first step to propose optimal integration of the areas of monitoring into areas of assessment. The monitoring areas, as defined in national IMAP Pollution - based monitoring progarmmes, provide a basis for proposing rules for integration of the areas of monitoring into areas of assessment, along with a consideration of the areas of assessment defined by the CPs within implementation of MSFD.

70. The harmonization of the scales approach between the Contracting Parties is the starting point to scale up the marine assessment to sub-regional and regional scales as required under IMAP. Despite the general agreement on the nested scales approach, the CPs are still required to agree on the common criteria and delimitation for the local/national areas for defining the areas of assessment. This may well vary between and within EOs, but pragmatic approaches are needed to allow assessment and management at all relevant levels.

71. The initial proposal of the scales of assessment for IMAP CIs, as agreed by the Meeting of CorMon on Pollution Monitoring organized in 2019 and the 7th Meeting of EcAp Coordination Group[14] is provided in Table 2, here-below.In order to further elaborate the proposal for assignment to the most appropriate scales of assessment of elements to be assessed, the national parts of areas of assessment at sub-division level need to be refined for the Parties that have recently prepared their national IMAP-based monitoring programmes, considering eco-geographical features, existing pressures, monitoring programmes and administrative boundaries.

72. The question that arises is how to define the most appropriate spatial areas for assessments that will lead to ecologically meaningful assessments of the environmental status, by applying the nested approach. In practical terms, for defining finer scales of assessment for the national part of the sub-divisions, it is recommended, to prepare the geographical information in the form of GIS based layers including those providing the following elements: (i) existing pressures: offshore platforms, navigation routes, ports, WWTPs, coastal industries, desalination plants, aquaculture units; (ii) sensitive areas: Ramsar sites, Natura sites, MPAs, etc.; (iii) spatial distribution of monitoring stations respectively areas of monitoring, including information on stations` position and type (Coastal Master, Coastal Hotspot, Open Master, Coastal Reference and Open Reference stations), as provided in national IMAP Pollution-based monitoring programmes; (iv) national administrative units i.e. the national administrative units/divisions of marine waters. The information layers provided on the country level can then be coupled and superimposed to one another level in order to produce one common map.

73. In this way, the geographical limits of the assessment areas can be defined on the national level and directly nested to the appropriate sub-division and sub-region level. It is therefore recommended to initiate discussions on the types of information (i.e. GIS layers) to be agreed among the CPs.

74. The following criteria could be considered for coupling the geographical information to define the appropriate areas of assessment: i) application of the risk assessment approach in order to ensure optimal spatial distribution of monitoring stations for EO5, EO9 and EO10 in coastal and offshore waters; ii) the representativeness of the areas of monitoring respectively determining whether they represent areas of high or low risk; this is related both to the spatial and temporal scales; iii) the co-existence of monitoring stations with pressures and/or sensitive areas, given that the defined areas of assessment should allow for capturing impact

[12]UNEP/MAP(2019). UNEP/MED WG.467/7. Cross-Cutting Issues and Common Challenges: The Methodological Approach for Mapping the Interrelations between Sectors, Activities, Pressures, Impacts and State of Marine Environment for EO5 and EO9.
[13] 7th Meeting of the Ecosystem Approach Coordination Group, Athens, Greece, 9 September 2019
[14] As provided in UNEP/MED WG.463/8 and in Annex I of UNEP/MED WG.467/7

and state in relation to the pressures; iv) sufficiency of quality assured data covering as many as possible IMAP Common Indicators to the extent possible that could be reported from monitoring stations established in given area of assessment in order to ensure reliable assessments; v) taking into account the administrative boundaries of the CPs, whilst being aware that these criteria may not necessarily lead to the assessment areas compatible with the national/local administrative geographical divisions.

75. After having defined the areas of assessment on the national level and according to the criteria described previously, the initial proposal of national parts of sub-divisions (coastal and off shore), as provided in Table 115, needs to be further elaborated. Then, their integration (up-scaling) into subareas and seas or to sub-region level can be made possible depending on the needs of the assessments by applying the rules for integration of assessments within the nested scheme as elaborated in section 4.2 here-below.

Table 1. The Mediterranean sub-regions and subareas aggregation according the database sources and availability proposed within the report (UNEP(DEPI)/MED WG.427/Inf.3) and documents (UNEP/MED WG.463/8 and UNEP/MED WG.467/7).

Sub-regions	Sub-division (e.g. subareas/seas)
Western Mediterranean Sea (WMS)	Alboran Sea (ALBS) North Western Mediterranean Sea (NWMS) Tyrrhenian Sea (TYRS) Western Mediterranean Islands and Archipelago (WMIA)
Adriatic Sea (ADR)	North Adriatic (NADR) Middle Adriatic (MADR) South Adriatic (SADR)
Central Mediterranean (CEN)	Central Mediterranean (CEN) Ionian Sea (IONS)
Aegean and Levantine Seas (AEL)	Aegean Sea (AEGS) Levantine (LEVS)

Table 2. Proposed assessment scales for IMAP Common Indicators (after 2017 MED QSR and 2017 MEDCIS workshop) as provided in UNEP/MED WG.463/5; UNEP/MED WG.467/7

EOs	**Common Indicators**	**Region**	**Sub-region**	**Sub-division**	**National part of sub-division**	**Coastal waters**
EO1	CI 1 Distributional range	Diving whales deep sea fish	Birds, small cetaceans, turtles, demersal and pelagic fish	Coastal fish and benthic species		
	CI 2 Condition species	Biogeographically-relevant scales				
	CI 3 Species distribution	Biogeographically-relevant scales				
	CI 4 Population abundance	Diving whales	Small cetaceans, turtles, demersal & pelagic fish	Coastal fish and benthic species		
	CI 5 Population demography	Diving whales	Small cetaceans, turtles, demersal & pelagic fish Coastal fish and benthic species			
EO2	CI 6 Trends in NIS	XX	XX	XX		
EO3	CI 7 Spawning stock Biomass	Ecologically-relevant scales, based on GFCM areas				

[1] Carbonell, A., Rios, B., Torres, A. P., Deudero, S., Alemany, F., Bellas, J., Dall' Angelo, C., Campostrini, P., Klancnik, K., Gorjanc, S., Koren, S., Mavric, B., France, J., Pastres, R., Marcomini, A., Basset, A., Zeri, C., Dassenaki, M., Paramana, T., Streftaris, N., Giannoudi, L., and Pagou, K. (2018). 'Report on proposals for optimizing existing MSFD related monitoring plans in the Mediterranean, focusing on NIS and Marine litter. MEDCIS Project, Deliverable 3.5', December 2019, 87 p.

	CI 8 Total landings					
	CI 9 Fishing Mortality	Ecologically-relevant scales, based on GFCM areas				
	CI 10 Fishing effort	Ecologically-relevant scales, based on GFCM areas				
	CI 11 CPUE/LPUE					
	CI 12 By-catch	Ecologically-relevant scales, based on GFCM areas				
EO5	CI 13Nutrients	X	X	X	XX	XXX
	CI 14 Chlorophyll-a					
EO7	CI 15 Habitats impacted			X	XX	XXX
EO8	CI 16 Erosion	X	X	XX	XXX	XXX
EO9	CI 17 Key harmful contaminants	X	X	XX	XXX	XXX
	CI 18 Pollution effects	X	X	XX	XXX	XXX
	CI 19 Acute pollution events	X	X	XX	XXX	XXX
	CI 20 Contaminants in seafood	FAO- GFCM areas	FAO- GFCM areas	Catch or Production Area		
	CI 21 Intestinal enterococci			X	X	XXX
	CI 22 Beached litter	Harmonized protocol				
EO10	CI 23 Litter at sea	Surface litter and microplastics				

76. At this point a reference can be made to the Commission Decision (EU) 2017/848, which sets out the criteria and methodological standards to be used for assessing the extent to which good environmental status (GES) is being achieved for the Marine Strategy Framework Directive (2008/56/EC). The Decision specifies the scale of assessment to be 'Subdivision of region or subregion reflecting biogeographic differences in species composition of the broad habitat type.' The regions and subregions are specified in MSFD Article 4 of which a map was agreed by the MSFD Common Implementation Strategy (CIS), based on the definition of a marine region in MSFD Article 3(2) which states that they are 'determined taking into account hydrological, oceanographic and biogeographic features'. MSFD Article 4 also has provision to define subdivisions to consider the specificities of a particular area to support implementation of the Directive.

77. Since the first reporting in 2012 of the initial assessment (MSFD Article 8), it has been the practice to geographically delineate the areas used for reporting (termed Marine Units in 2012, but now referred to as Marine Reporting Units – MRUs, Fig.2). This is to ensure that the information reported is clearly linked to specific parts of a marine region, subregion or Member State's marine waters, and to enable the reported information to be displayed in maps to show, inter alia, the extent to which GES has been achieved (for example in WISE-Marine). In 2012 MRUs were defined by the Member States, and the approaches to define them varied considerably between Member States and between descriptors (DIKE_16-2017-03).

78. The Marine Reporting Units used in the Marine Strategy Framework Directive (MSFD) during the 1st reporting cycle (2012-2018) and those submitted to be used during the 2nd reporting cycle (2018-2024) can be found at https://discomap.eea.europa.eu/INSPIRE/GMLMarine/atomMarineReportingUnits.xml in European Environment Agency (EEA) 2020-03-09T00:00:00Z European Environment Agency https://www.eea.europa.eu/ sdi@eea.europa.eu. The MRUs are made available in GML and SHP format.

79. These Marine Reporting Units (MRUs) in compliance with the above are used within the reporting obligations of the Marine Strategy Framework Directive (MSFD), in order to link the implementation of the different articles to specific marine areas. The MRUs can be of varying sizes, according to the appropriate scale for the different reports (e.g. region, sub-region, regional or sub-regional subdivision, Member State

marine waters, WFD coastal waters, etc.), as was also indicated in the Good Environmental Status 2017 Decision.

Figure 2: Overview of MRUs in European regional Seas (EEA (2020). Marine Reporting Units used in Marine Strategy Framework Directive (MSFD) 2012-2018 reporting cycle - version 1.0, Feb. 2020, which can be found at: https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/99869345-d8b0-4933-a9d0-3c9e08055c4a).

80. According to the SEABED_5-2021-06 Document prepared by Sander Wijnhoven on 15th February 2021 (can be found at MSFD CIS: TG SEABED documents on CIRCABC), following the 2012 reporting, discussions on assessment scales and areas within the MSFD Common Implementation Strategy (CIS), particularly in the Working Group on Good Environmental Status (WG GES), a focus was on the need for a more coherent approach. This led to inclusion of assessment scales in the 2017 GES Decision and progress towards more consistent approaches, including the coordinated systems used for HELCOM's HOLAS II and OSPAR's Intermediate Assessment 2017.

81. Therefore, accepting a nested scheme of assessment units (re-using parts of boundaries at different scales as much as possible) makes that indicators or criteria, most appropriate to be assessed representatively at a large(r) scale (than identified MRUs), can easily be broken down into MRUs, accepting large scale assessment results at the smaller (MRU) scales as well (Figure 3). The other way around, combining representative small-scale assessment results to an assessment at larger scale, is done on a surface area ratio basis. Qualitative assessment results for small scale areas are combined quantitatively by summing partial results that are multiplied with their share on the total surface area to be assessed. Subdivisions of MRUs can be of any kind and could be valuable for reporting as well (especially with regards to management evaluations or other policies reporting). With regards to the MSFD, reporting at smaller than MRU scale could particularly be of interest to indicate the national share in results at (often international) MRU scale. This smaller scale reporting is optional and encouraged in case pressure patterns display a clear spatial pattern, with the emphasis on a specific area or when measures are taken at national scale. At least from the assessment perspective the use of representative small-scale results might provide more accuracy, as well as the opportunities to optimally use measurement and monitoring designs already in place for other purposes. It may also provide better insight in management perspectives. As potentially used smaller scales are flexible, with regards to those units a reference can be made to Additional Marine Units (AMUs) with the special case of a national part of an MRU.

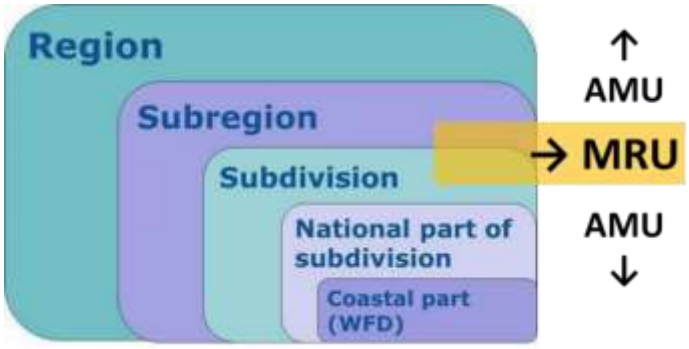


Figure 3: Schematic representation of a nested set of assessment units of relevance with regards to MSFD assessments. Five levels of assessment units are indicated that could be reporting units with regards to other policies, management evaluations or other MSFD criteria. With regards to the MSFD Descriptors evaluation, Marine Reporting Units (MRUs) are distinguished at the level of subdivision of (sub)region (dependent of whether subregions are distinguished). All other assessment units (larger and smaller) can be of use as Additional Marine Units (AMUs) to support MSFD assessments and can even be used in MSFD reporting (e.g., national share in assessment result of MRU, or the SAUs of the NEAT tool, see chapter 5.2d). This is optional.

82. The reporting requirements in 2018 under the MSFD for the CPs that are EU MSs, according to article 17(2) of the MSFD16, were to update their marine strategies every six years. This required articles 8 (initial assessment), 9 (determination of the Good Environmental Status) and 10 (establishment of targets) to be updated by 15 July 2018, and notified to the European Commission (EC) by 15 October 2018 at the latest. Therefore, a reporting guidance was prepared by EEA and DG ENV to facilitate this reporting.

83. Within this guidance, as has been the practice with previous reporting round for MSFD, all articles to be reported are linked to a specific Marine Reporting Unit (MRU, previously termed Marine Unit), thereby linking the reported information to a specified part of the marine waters. The MRUs can be of varying sizes, according to the appropriate scale for the different reports (e.g. region, subregion, subdivision, MS waters, WFD coastal waters, etc.), as indicated in the new GES Decision in 2017 by the scale of assessment to be used. The EEA/ETC-ICM developed reference layers of Marine Reporting Units (https://www.eea.europa.eu/ sdi@eea.europa.eu) to cover the European seas, including the following layers: a. Regions, b. Subregions, c. Subdivisions of the regions and subregions, where available (e.g. from RSCs), d. National part of a region, subregion or subdivision, e. WFD coastal waters / WFD territorial waters/ Beyond territorial waters. Since there are topological problems (mainly overlaps and gaps) in the GIS data on national marine boundaries submitted by Member States in 2012, whenever such discrepancies are resolved amongst Member States, MSs should upload updated national marine boundary data to the Central Data Repository (CDR). However, the set of subdivisions (also referred to as 'assessment areas' in previous guidance, 'sub-basins' in HELCOM, etc.) used for reporting is more established in the Baltic and Atlantic regions than in the Mediterranean and Black Sea regions. Consequently, until such (sub)regionally agreed subdivisions are in place, it is possible for MSs to use and update their existing national reporting areas. This can be done via updates to the schema '4geo.xml' and provision of associated GIS shapefiles.

84. Measurements and therefore assessment results can vary from being spatially continues via high density to relative low density point measurements being either field observations or modelling results. Dependent of the used indicator or approach, assessment results can in principle be grid-based or come as shapes. Both can be used but should be translated into an assessment result at the level of an MRU in the same way leading to an assessment result combining quality and quantity (considering uncertainty as well, see also chapter 5.2.d). The grid-based approach is subdividing an assessment unit (as an MRU) in various fixed size small scale assessment units (as SAUs for the NEAT tool, chapter 5.2.d), as a way of qualification and quantification, where the share of grid cells with (reliable) information can indicate the degree of uncertainty for a large-scale assessment. For using grids, it is of importance to use a fixed size, or in case more detailed information forms the bases, results are first translated into the agreed grids, as grid size will have an impact on assessment results. As for grid cells also the relative size of an MRU might have an impact on assessment

[16] European Commission, 2018. Reporting on the 2018 update of articles 8, 9 & 10 for the Marine Strategy Framework Directive. DG Environment, Brussels. pp 71 (MSFD Guidance Document 14).

results. Although there will be some relation with scale, the importance of a scale-effect will deviate from one (sub)region to the other as well. Additionally, the scale-effect might differ per indicator. With regards to comparability, it might be recommendable to select MRUs of about similar size and structure within (sub)regions, although optimum size (within MRU variability) seems to be a typical biogeographic characteristic as well.

85. Also set minimum essential monitoring or measurement effort is something that is indicator and area specific and depends on the status as well. It is however likely that using smaller assessment scales as AMUs (of which results are used for compilation of the assessment at the MRU level) at a certain level of reduction of the size might result in deviation of the assessment results (i.e., in practice the used reference might need adjustment). Making use of AMUs requires AMU-specific power analyses, at least, so that uncertainty can be taken into consideration. The definition of MRUs will likely drive monitoring (adjustments of designs in the future), as a representative and comparable monitoring at the MRU scale is most efficient.

86. The process of defining MRUs should be based on biogeographical patterns. For example, the abiotic types of habitat of the same kind in different biogeographical (sub)regions will likely support about similar functional communities, however with varying species compositions. Important abiotic characteristics resulting in the largest/most distinguishing communities are related to temperature and salinity. An overview of possible biogeographical divisions and a proposal based on that is provided by Dinter (2001). These are however large units that includes benthic and especially pelagic aspects. Although reporting is already at the level of (broad) habitats, large patterns in habitat distributions (concerning depth and substrate characteristics reflecting dominant hydrodynamic patterns, defining connectivity and species distribution patterns) are of importance in distinguishing subregions as well (e.g., Gubbay, 2014; HELCOM Monitoring and assessment strategy). Other parameters like trophic states, oxygen conditions and light penetration could be of relevance for specific regions if they are natural occurring phenomena and not the result of anthropogenic activities.

87. EU MSs in Mediterranean have reported a varying number of MRUs in 2012 (see Figure 2 and their details can be found in https://www.eea.europa.eu/ sdi@eea.europa.eu: 1) Croatia has defined its entire marine waters in the Adriatic as the overall assessment area (all in Subregion: Adriatic Sea (ADR), subdivision Middle Adriatic (MADR), assessment area: MADRHR (= one MRU), but has reported six separate sub-assessment areas, with three of them covering coastal waters and three open waters; 2) Cyprus reported marine waters in Eastern Mediterranean Sea (Levantine) and all MSFD monitoring is realized in the Aegean-Levantine Subregion (MAL), with one assessment area (MRU): MALC; 3) France is part of two marine regions, the North East Atlantic Ocean and the Mediterranean Sea. In the Mediterranean, it has marine waters in the sub-region 'Western Mediterranean' with one assessment area (MRU): MWEFR; 4) Greece's marine waters belong to one marine region of the Mediterranean Sea, and three marine subregions, the Adriatic Sea, the Ionian Sea and Central Mediterranean Sea, and the Aegean-Levantine Sea. In 2012 Greece submitted 6 assessment areas (MRUs), one in Adriatic Sea (MAD-EL-MS-AD), one in Ionian Sea and Central Mediterranean Sea (MIC-EL-MS-IO) and 4 in Aegean-Levantine Sea: Levantine Sea (MAL-EL-AA-LE), 3 in Aegean Sea, which are South Aegean Sea (MAL-EL-AA-SA), Central Aegean Sea (MAL-EL-AA-CA), and North Aegean Sea (MAL-EL-AA-NA). 5) Italy's marine waters are part of the marine region of the Mediterranean Sea and cover the subregions of the Adriatic Sea, the Ionian Sea and the Central Mediterranean Sea and the Western Mediterranean Sea; 6) The Maltese Islands are part of the Mediterranean region and specifically the Ionian Sea and the Central Mediterranean Sea sub-region (MICMT) with one MRU; 7) Slovenia's marine waters are part of the marine sub-region of the Adriatic Sea (MAD). No more formal subdivisions were found; 8) Spain has 2 marine subdivisions in Mediterranean Sea: the Levantine Balearic Sea (LEBA), and Estrecho and Alboran (ESAL), each with one MRU. Therefore, in 2012 17 MRUs have been reported by the CPs that are Mediterranean EU MSs.

4. Rules for integration of monitoring and assessment areas within IMAP Pollution and Marine Litter Cluster (EO5, EO9, EO10), considering also its interrelation with the Coast and Hydrography (EO6, EO7) and Biodiversity (EO1) Clusters.

88. The rules or guidelines for integration of monitoring activities can be applied on each EO separately, or on each IMAP cluster or across clusters. In all cases the rules for establishing an integrated monitoring scheme aim to provide integrated assessments in a cost-effective way that is built on the interrelations of the

EOs and CIs. Rules for establishing the integrated monitoring programmes are closely linked to those for integrated assessments. The interrelations of EOs and in particular the links between Pressure – Impact - State CIs of IMAP have been outlined in UNEP/MED WG.463/5 and UNEP/MED WG.467/7, and are provided in Table 3.

Table 3: A framework for integrated GES assessment, as provided in UNEP/MED WG.463/5; UNEP/MED WG.467/7, showing IMAP Common Indicators in relation to the predominant pressures. EOs/Cells in Orange concern pressures (P); IMAP Common Indicators in yellow concern impacts (I) and ecosystem elements in grey cells concern state. Some EOs are repeated, as they are applicable to several ecosystem elements (species groups, pelagic and benthic habitats). EOs for which Common Indicators are not defined (EO 6, 7 and 11) are not considered in the table. Cells marked with '?' indicate situations where an impact from the pressure is possible without any possible assessment.

ASSESSMENT OF GOOD ENVIRONMENTAL STATUS (GES)					Assessment of pressures				
					EO 2	EO 3	EO 5	EO 9	E0 10
					Nis	Extraction of wild species	Eutrophication	Contamination	Marine Litter
					Common Indicators of pressure				
					CI 6	CI 8, CI 10, CI 11	CI 3	CI 17, CI 19	CI 22, CI 23
Assessment of state	EO 1, EO 3	Species (birds, turtles, fish etc.)	State indCIators	CI 1 to 5, CI7, CI9	CI 3-5, C I7	CI 9, CI 12	?	CI 18, CI 20-21	CI 24
	EO 1, EO 3	Pelagic Habitats		CI 1 to 5, CI7, CI9	CI 3-5, C I7	CI 7, CI 9, CI 12	CI 14	CI 18, CI 20-21	CI 24
	EO 1, EO 3	benthic habitats		CI 1 to 5, CI7, CI9	CI 3-5, C I7	CI 7, CI 9, CI 12	CI 14	CI 18, CI 20-21	CI 24
	EO 1, 2, 3, 4	ecosystems		CI 1 to 5, CI7, CI9	CI 3-5, C I7	CI 7, CI 9, CI 12	CI 14	?	?

89. By taking account of this initial work, as well as the relevant best practices coming from the EU MSFD implementation and IMAP monitoring practices, including an initial proposal of the interrelations of CIs as provided in National IMAP-based monitoring programmes of Montenegro, the proposal of interrelations of IMAP CIs of EO5, EO9 and EO10, as well as their interrelations with EO1, EO7 and EO8 is provided here-below.

90. The rules for establishing interrelations of relevance for monitoring interconnections of CIs of EO5 and CIs of EO1, EO3, EO7, EO8, EO9 and EO10 are provided here-below in Table 4; the rules for establishing interrelations of relevance for monitoring interconnections of IMAP CIs of EO9 and CIs of EO1, EO3, EO5, EO7, EO8 and EO10 are provided in Table 5; and the rules for establishing interrelations of relevance for monitoring interconnections of IMAP CIs of EO10 and CIs of EO1, EO3, EO5, EO7, EO8 and EO9 are provided in Table 6.

91. Furthermore, such defined interrelations have been applied on national IMAP Pollution-based monitoring programmes /MSFD monitoring programmes, in order to (i) map across the EOs the relations of the state - impact - pressure CIs and identify CIs indicative of same pressures i.e. pressures originating from common drivers/economic sectors and (ii) conclude at what level these interrelations have been applied in present IMAP monitoring practices. Detailed analysis on CPs IMAP implementation as presented above in chapter 2, has shown good interrelations of CIs in the Pollution & Marine Litter Cluster but rather weak interrelations with the other IMAP clusters. More efforts in a coordinated way are needed among the three IMAP clusters expert teams in each country in order to deliver meaningful results for integrated assessments as required by the IMAP programme.

Table 4. EO5 EUTROPHICATION: Interrelations of IMAP Common Indicators 13 and 14 of EO5 and IMAP Common Indicators of EO1, EO3, EO7, EO8 and EO9.

Ecological objective	Common Indicator	Interrelations with CIs 13 and 14 of EO5	Monitoring interconnections
EO1 Marine Habitats	CI1: Habitat distributional range (to also consider habitat extent as a relevant attribute) STATE	Excessive concentrations of nutrients and chlorophyll a may cause chemical and transparency change with consequent effects on habitat communities. The excessive nutrients concentrations may cause increased abundance of phytoplankton biomass (chlorophyll-a - CI14) and macroalgae, as well as proliferation of opportunistic and HAB species with consequent effects on habitat communities, for example phytoplankton blooms may reduce light availability for marine plants. PRESSURE, IMPACT	If possible, overlapping of EO5 stations is desired with the key locations of benthic habitats with plant species, preferably also within the MPA (as a reference station).
EO1 Marine Species	C2: Condition of the habitat's typical species and communities STATE		
EO3	CI7: Spawning stock Biomass STATE	Nutrients and chlorophyll a can possibly impact the spawning stock biomass through the changes in chemical conditions and transparency	
EO7	CI15: Location and extent of the habitats impacted directly by hydrographical alterations. IMPACT	An interrelation with monitoring of eutrophication can be expected since among others turbidity, which might be related to increased eutrophication, can play a crucial role in maintaining marine habitats PRESSURE	Basic hydrographic data should be collected and reported on all EO5 stations, such as temperature and salinity, to define the major coastal water types for eutrophication assessment.
EO8	CI16: Length of coastline subject to physical disturbance due to the influence of man-made structures. PRESSURE	Since eutrophication is related to urbanized areas due to nutrient increase (CI 13) through the anthropogenic (particularly non-treated or not appropriately treated) wastes Another interrelation is with EO8 - CI16 (as physical disturbance due to man-made structures can affect hydrographical characteristics as are turbidity, currents, release of nutrients) PRESSURE	The type of construction/infrastructure on the coastline is determined as part of EO8 monitoring. To some extent, it could contribute towards identifying type of pressure coming from human sources relevant for monitoring at EO5 stations. In addition, information coming from EO5 monitoring could complement EO8 monitoring.
EO9	CI17-CI20		Integration of sampling stations for EO5 and EO9 ensures cost-effectiveness.

Table 5. EO9 CONTAMINANTS: Interrelations of IMAP Common Indicators of EO9 and IMAP Common Indicators of EO1, EO5, EO7, EO8 and EO10.

Ecological objective	Common Indicator	Interrelations with CIs of EO9	Monitoring interconnections
EO1 Marine Habitats	CI2: Condition of the habitat's typical species and communities STATE	CI18: Biological effects It can be expected that ecotoxicological pollution has impacts on species. The unwanted effects include harm to organisms at lower levels of the food chain and a magnification of concentrations through food webs, resulting in higher concentrations and potential impacts at the top of the food chain. CI19: Biological effects from accidents/oil spills can have significant impacts on species CI20: Actual levels of contaminants in seafood IMPACT	The results of the EO9 monitoring could be taken into considerations to complement EO1 monitoring (in terms of identification of pressures); therefore, it should be recommended for selection of monitoring areas for EO9 to consider a distribution of marine habitats and species
EO1 Marine Species	CI3: Species distributional range CI5: Population demographic characteristics STATE		
EO3	CI7: Spawning stock biomass	CI20: Actual levels of contaminants in seafood IMPACT	Sampling for CI20 can be conducted along with CI7,
EO5	CI13, CI14 PRESSURE	CI17, CI21 PRESSURE	It is recommended to ensure Common sampling locations for EO5 and EO9 mainly due to cost- effectiveness of monitoring efforts.

Ecological objective	Common Indicator	Interrelations with CIs of EO9	Monitoring interconnections
EO7	CI15: Location and extent of the habitats impacted directly by hydrographical alterations. IMPACT	CI17, CI21 are directly linked to anthropogenic pressures such as coastal urban development, port facilities, dredging, dumping, mining, etc. PRESSURE	Basic hydrographic data should also be collected and reported on all EO9 stations, such as temperature and salinity. The areas/monitoring units for CIs 17, 21 are closely associated with those of CI15 following a need to apply the risk-based approach for defining the monitoring network.
EO8	CI16: Length of coastline subject to physical disturbance due to the influence of man-made structures. PRESSURE		The monitoring areas/stations for CIs 17, 21, are closely associated with those of CI16 following a need to apply the risk-based approach for defining the monitoring network.
EO10	CI22: Trends in the amount of litter washed ashore PRESSURE	CI21: Marine litter can carry pathogens PRESSURE	Overlapping of monitoring areas/units should be considered, as to allow recording of marine litter CI 22 parameters whilst monitoring of CI21 takes place, as appropriate and feasible
	CI23: Trends in the amount of litter in the water column including microplastics and on the seafloor CI24: Trends in amount of litter ingested PRESSURE, IMPACT	CI17, CI20: Marine litter, in the form of microplastics, can carry and release chemical contaminants into the marine environment or transfer them directly to marine organisms after ingestion. PRESSURE, IMPACT	Overlapping of monitoring areas/units should be considered, as to allow recording of marine litter CIs 23 and 24 parameters whilst monitoring of CIs 17 and 20 takes place, as appropriate and feasible

Table 6. EO10 MARINE LITTER: Interrelations of IMAP Common Indicators of EO10 CIs and IMAP Common Indicators of EO1, EO5, EO7, EO8 and EO9.

Ecological objective	Common Indicator	Interrelations with CIs of EO10 CIs	Monitoring interconnections
EO1 Marine Habitat	CI1: Habitat distributional range (to also consider habitat extent as a relevant attribute) CI2: Condition of the habitat's typical species and communities STATE	CI23: Litter on the sea bottom damages benthic species and can affect distribution of habitats. Information on type and amount of the marine litter is relevant for the assessment of pressures to the benthic habitats. PRESSURE	Data from EO1 monitoring could complement monitoring of sea floor marine litter. Also, results of the EO10 monitoring could complement EO1 monitoring. Overlap of monitoring areas/ units is required.
EO1 Marine Species	CI3: Species distributional range. CI4: Population abundance of selected species CI5: Population demographic characteristics STATE	CI24: Marine litter could cause significant impacts to marine mammals, reptiles and marine birds, through ingestion and/ or entangling. The unwanted effects include harm to organisms at lower levels of the food chain and a magnification of concentrations through food webs, resulting in higher concentrations and potential impacts at the top of the food chain. IMPACT	
EO3	CI7: Spawning stock Biomass		In order to ensure cost-effectiveness, expeditions undertaken for EO3 monitoring could, at the same time, be used for EO10 (offshore seafloor and surface monitoring).
EO5	Whilst monitoring of CIs 13 and 14 takes place, recording of marine litter CIs parameters should be undertaken, as appropriate and feasible		

Ecological objective	Common Indicator	Interrelations with CIs of EO10 CIs	Monitoring interconnections
EO7	No interrelation - interconnection		
EO8	CI16: Length of coastline subject to physical disturbance due to the influence of man-made structures. PRESSURE	CI22: Trends of marine litter washed ashore. Directly linked to anthropogenic pressures such as coastal urban development, port facilities, dredging, dumping, mining, etc.. PRESSURE	The areas/monitoring units for CI22, are closely associated with those of CI16 following a need to apply the risk-based approach for defining the monitoring network
EO9	Whilst monitoring of CIs of EO9 takes place, recording of marine litter CIs parameters should be undertaken, as appropriate and feasible		

4.1 Rules for integration of monitoring efforts within relevant monitoring units

92. An analysis of available National IMAP Pollution-based monitoring programmes illustrates the homogenous coverage of the sampling areas/stations in the South and Eastern Mediterranean. It reveals high distribution of stations for the coastal waters. Despite a good coherence and comparability of the spatial coverage of the scales of monitoring, there are some proportionally small areas where information was not yet available from some CPs (i.e. Albania[17], Turkey and Syria). A detailed analysis of present monitoring practices established by the CPs for EO5, EO9 and EO10 has been described previously in chapter 2.

93. With regards to the Contracting Parties which are EU member States (MEDCIS Deliverable D3.5 – Carbonell et al. 2018[1]), the majority of monitoring activities within MSFD are carried out within the coastal areas of marine demarcations, since 38% of monitoring subprograms are carried out exclusively in transitional waters and within the first mile from coastline (WFD monitoring), and 19% of subprograms cover also waters up to 12 miles offshore. This, besides 3% of monitoring special areas and 4% in terrestrial part of MSs, makes that monitoring subprograms covering offshore areas represent only 36% of total.

94. Considering above presented spatial coverage of the monitoring areas and having established the links and interrelationships of CIs within IMAP Pollution and Marine Litter Clusters, as well as across IMAP Pollution, Biodiversity and Coast & Hydrography Clusters (Tables 4, 5 and 6), the proposal for integration of monitoring areas/units for the respective CIs is defined in Table 7 below. The associations are made also in relation to the spatial scale and environmental matrix as defined within the IMAP Guidance Factsheets for eutrophication (EO5), contaminants (EO9) and marine litter (EO10). For the state indicators of EO1, the habitat type and specific species relevant to the data collected within the Pollution Cluster is noted. Further details related to the parameters measured and temporal scales for EO5 and EO9 can be found in UNEP/MED WG. 463/8, as well as in UNEP/MED WG.467/5[18].

Table 7. Monitoring units and environmental matrices interrelated for the CIs of EO5, EO9 and EO10, as well as for the EO1, EO7 and EO8

	Monitoring unit					
	Coastal waters			Offshore waters		
Pressure related CIs						
	water	sediment	biota	water	sediment	biota
EO5	13, 14[+]	13[**], 14	14[+]	13, 14[+]	13[**], 14	14[+]
EO9	19[*+], 21	17	20[+]	19[*+]	17	20[+]
EO10	23	22, 23	24[+]	23	23	24[+]
EO8	16 Length of coastline			-		
Impact related CIs						
	Biota			Biota		
EO5	14[+]			14[+]		
EO9	18, 19[*+], 20[+]			18, 19[*+], 20[+]		
EO10	24[+]			24[+]		
EO7	15			15[†]		
State related CIs						
EO1	1	2, 3, 5		1	2, 3, 5	

[17] Finalization of national Pollution, Biodiversity and Coast and Hydrography IMAPs for Albania is expected within implementation of GEF Adriatic Project

[18] UNEP/MAP (2019 c). UNEP/MAP WG.467/5. IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21; New proposal for Candidate Indicators 26 and 27

	Seabed habitats	Marine reptiles	Seabed habitats	Marine reptiles

[*]Depending on the monitoring unit, the accident may happen in either coastal or offshore waters, so the monitoring unit for this CI cannot be fixed a priori

[**]Monitoring of nutrients is important for water sediment interface, including in offshore areas, especially where important estuaries exist

[+]Both pressure and impact CIs

[†] Related to offshore structures

4.2 Rules for integration of assessments within the nested approach

95. As stated in the introductory remarks of the present document, the areas of monitoring may not necessarily be identical to the areas of assessment depending on the specificities of the parameters monitored and their ecological relevance. Compatibility between pressure-impact and state assessments should also be ensured based on the interrelations of CIs and EOs. Further to methodology explained above for establishing the areas of assessment based on areas of monitoring, in order to produce an assessment at the regional or sub-regional level as IMAP requires, it is of outmost importance that the nesting of assessment areas has been agreed for IMAP. However, for the meaningful GES assessments within the nested scheme, the spatial assessment units need to be optimally considered when applying the assessment methods described below in chapter 5.

96. A distinction should be made between the CIs and EOs which are related to point sources and are monitored according to the risk-based approach (e.g. eutrophication), and those which provide information on both local and transboundary features of pollution (e.g. marine litter, or mobile species). During the process of integration of assessments into higher levels, the results for CIs and EOs related to point sources should be treated so as to hold a relative weight of significance within the assessment area. For example, eutrophication (EO5) is related to land-based inputs and the information/data collected in coastal monitoring units are indicative of the status for coastal waters only, while data collected in the offshore monitoring units are indicative of the offshore status. Assessments made on the subdivision level, or higher level (i.e. sub-regional/regional levels), should take into consideration that the results on coastal and on offshore trophic status cannot be integrated in the same way, i.e. do not have the same weight of significance, for the whole assessment area.

97. Another important criterium is the implementation stage of the IMAP monitoring activities among countries and the availability of monitoring data. For IMAP CIs 13, 14, 17, 18, a weighting factor and integration of assessments up to the subdivision level is recommended. For CIs 19, 20, 23 (sea surface microplastics), and CI24, an integration up to either the subdivision or the subregion level is considered meaningful and a weight factor is not needed. For CI21 which is relevant to local conditions in coastal waters, the integration of this information beyond the national coastal waters part of the subdivisions is open for discussion. For CI22 beach litter and CI23 seabed litter assessments can be made by applying or not applying a weight factor depending on the policy needs and targets, while assessments are meaningful for both cases up to the subregion level. A very high level of integration on the subregion or even region level can be done, but it may mask the information on the lower levels and impact negatively the decision-making process.

98. The above findings are shaped in a tabular matrix of the nesting aggregation scheme for areas of assessment (Table 8). This proposal further refines the initial proposal for IMAP EOs 5, 9 and 10 as presented in Table 2 and explained above in Chapter 3. It is also compatible to the MSFD implementation guidance. The colours in Table 8 correspond to the assessment levels. For the CIs which require a weighted approach within the assessment areas a further discrimination is made. The degree of recommendation for meaningful assessments per CI is shown by the “X” sign.

Table 8. Upgraded aggregation scheme for areas of assessment for EO5, EO9, EO10 within the nested approach.

Mediterranean Region		
	Subregion (i)	
		Subdivision (i)
		National part

EOs		CIs			National offshore waters	National coastal waters
EO5		CI 13 Nutrients	X	X	XXX	XXX
		CI 14 Chlorophyll-a	X	X	XXX	XXX
EO9		CI 17 Key harmful contaminants	X	X	XXX	XXX
		CI 18 Pollution effects	X	X	XXX	XXX
		CI 19 Acute pollution events and their effects	X	XXX	XXX related to where the event happened	
		CI 20 Contaminants in seafood	XX	XXX according to FAO areas	XXX according to FAO areas	
		CI 21 Intestinal enterococci				XXX
EO10		CI 22 Beached litter	X	X	XXX	XXX
		CI 23 Litter at sea	XX	XXX seabed litter	XXX seabed litter	XXX seabed litter
			XX	XXX sea surface microplastics	XXX sea surface microplastics	
		CI24 Ingestion and entanglement	XX	XXX	XXX	

The colors correspond to the levels of assessment scales (Light blue: Region; Light green: Sub-region; Light purple: Sub-division; Dark purple: Sub-division weighted results).

Xs denote the degree of recommendation of spatial scale for the assessment of specific CIs within the IMAP programme (XXX: strong; XX: medium; X: weak).

99. For implementation of this updated nested aggregation scheme, there is a need to define the scales of assessment at national part of sub-division level. Further progress in that respect depends on submission of relevant spatial distribution maps of the monitoring and assessment areas as defined within implementation of national IMAP-based monitoring programmes, respectively MSFD monitoring strategies, following the methodology for coupling of relevant geographical information in the form of GIS-based layers and by applying suggested aggregation criteria, as explained above in chapter 3. To that end, the CPs need to make available the information presented here-below in Table 9.

Table 9. Tentative list of information needed for defining the national part of the sub-divisions within upgraded nested assessment scheme

A) The following information on the national level is indispensable for building areas of assessment from monitoring areas.

Type of information	**GIS layer** (indicate type of file)*	**Excel table** (Lat, Lon)**	**Other** (please specify, including relevant narrative methodological explanations)
monitoring stations/area at sea clearly defining the type of station (coastal, hot spot, offshore, reference)		**Y/N (yes or no)**	
area of assessment(s)***			
monitoring beaches			
bathing waters locations			
sensitive areas including MPAs and Natura sites			
Ports			
aquaculture units			
desalination plants			
operating offshore installations			
planned offshore installations			

* A shapefile with the locations of the stations in WGS84 projection system.
**Answers with YES or NO if position coordinates are available, in excel format, for each type of information (e.g. for stations, ports, desalination plants etc.) whereas longitude and latitude are provided in decimal degrees format (i.e. 23.45674 - 34.98765) with five digits. For each record a column needs to indicate the type of the station either in full name or in coding (Coastal Master, Coastal Hotspot, Open Master, Coastal Reference and Open Reference stations or CM; CH; OM; CR and OR)

*** For CPs which are EU Member States

B) Information related to distribution of stations in the respective sub-division(s) of the Mediterranean Region, according to the following example:

Country Name	Sub-division (1)	Sub-division (2)	Sub-division (3)
	Aegean Sea	Levantine Sea	Ionian Sea
Greece	40	4	25

5. Rules for aggregation – integration towards GES assessment

100. In cross-cutting document elaborated for IMAP Pollution and Marine Litter Cluster (UNEP/MAP 2019b)19, several methodological approaches have been outlined to interrelate the CIs of EOs by applying DPSIR approach, as one of key elements of integrated GES assessments. They take into consideration the predominant pressures and their impacts on the marine and coastal environment to assess the state of the marine environment (i.e. DPSIR-based assessments) and as a consequence, policy responses (e.g. measures and priority actions) that can be built to address the drivers (e.g. economic sectors and activities) causing the degradation of the marine ecosystem and its ecosystem services. In present document these methodological approaches are taken into account and further complemented, especially those which have a semi-quantitative character, in an attempt to propose an integrated GES assessment scheme based on actual monitoring data for EO5, EO9 and EO10, and application of the criteria of assessment within aggregation of assessment findings at optimally nested scales of assessment.

101. Namely, the following two types of methodological approaches were elaborated: i) those which provide interactions between pressures and impacts for EO5, EO9 and EO10 i. e. GRID/Table Approach and Scoreboards Method (Tables 1, 2, 3 in document UNEP/MAP WG.467/7), based on known pressures at source (economic driver) and are based on expert judgment, and ii) those which refer to GES assessment methods based on monitoring data i.e. NEAT Approach and UN regional Seas Programme Approaches (Chapters 2.3, 2.4 in document WG.467/7). There is a need to optimally interrelate/compare the two types of methodological approaches within the defined areas of assessment. In that respect the paragraphs 5.1 and 5.2 describe the most appropriate methods for GES assessment based on monitoring data by applying the assessment criteria, whilst paragraph 5.3 provides a proposal for comparison with Drivers and Pressures at source.

5.1 Assessment Criteria

102. The GES assessment follows specific methods (i.e. numeric calculations) which aggregate and integrate the monitoring data at the appropriate assessment scales, as explained above. The application of assessment methods however, requires two assessment criteria: (i) a threshold value for each parameter/element monitored, which defines the quality status, and (ii) a decision rule regarding the spatial extent within an assessment area, that achieves such quality status. For example, it is possible that an element/parameter measured across an assessment area gets values both above and below the threshold value (e.g. Hg measured in 10 stations of coastal waters is found above threshold in 3 of them and below threshold in 7 of them), so a decision needs to be taken regarding the achievement or not of GES for the particular assessment area or MRU.

103. The explanation and definition of threshold values in the context of the IMAP process has been analyzed in UNEP/MAP (2019b)20 related to cross-cutting issues. The threshold value for a parameter/element of IMAP CI is set so that it allows for an assessment of the quality level achieved for a particular CI or EO in relation to the degree of change from reference conditions. The thresholds for EOs 5, 9 and 10 are set on the CI level. For EOs 5 and 9, the thresholds are related to harmful/toxicological impact, and/or disruption of human activities (EO9/ CIs 20 and 21). For EO10 thresholds are related to both

[19] UNEP/MAP (2019b). UNEP/MED WG.463/7; UNEP/MED WG.467/7. Cross-Cutting Issues and Common Challenges: The Methodological Approach for Mapping the Interrelations between Sectors, Activities, Pressures, Impacts and State of Marine Environment for EO5 and EO9.
[20] UNEP/MAP (2019b). UNEP/MED WG.463/7; UNEP/MED WG.467/7. Cross-Cutting Issues and Common Challenges: The Methodological Approach for Mapping the Interrelations between Sectors, Activities, Pressures, Impacts and State of Marine Environment for EO5 and EO9.

toxicological and physical damage. In the absence of information related to toxicological effects or damage, thresholds can be set based on baseline values.

104. Setting and adopting baselines and threshold values for the Mediterranean Sea in the context of IMAP, is an ongoing process. Regarding EO5, the On-line expert group on eutrophication21 recommended that with regards to nutrient concentrations (CI13), until commonly agreed thresholds have been determined, negotiated and agreed upon at a sub-regional or regional level, GES may be determined on a trend monitoring basis. With regards to chlorophyll a (CI14), the On-line expert group on eutrophication recommended the reference and threshold values of the MEDGIG approach to be used for assessing eutrophication status. Accordingly, for chlorophyll a the reference conditions and boundaries for G/M status in Mediterranean coastal water types have been agreed by Decision 22/7 (COP 19)22. Since then, the assessments of the eutrophication status of the Mediterranean Sea follows the same methodology used in 2017 MED QSR, i.e. the. reference conditions and boundaries in coastal water types. The main statistical analysis is based on the typology criteria and settings derived from the analysis of influence of freshwater inputs as the main nutrient drivers23. To enforce GES assessment regarding eutrophication, present efforts are aimed at proving initial proposal of the methodology for establishing the assessment criteria for nutrients as provided in document UNEP/MED EG.492/11 submitted for consideration of present Meeting.

105. For EO9, the environmental assessment criteria (EACs; either ECs or ERLs for biota and sediment matrices, respectively), were adopted in Decision IG. 22/7 (COP19) and revised in Decision 23/6 (COP 20) based on European policy and US ERL values, for biota, sediment samples and biomarkers. BACs are established at regional level, while an initial proposal of BACs values for heavy metals in biota and sediment at the level of 4 Mediterranean sub-regions is brought for information to the 2019 Meeting of CorMon on Pollution Monitoring. Further upgrade/update of the assessment criteria related to Trace Elements (TEs), Organic Contaminants (OCs) and Bio-markers, along with an upgraded methodology for their calculation, is provided in document UNEP/MED WG. 492/12 submitted for discussion of present Meeting.

106. During the Integrated Meetings of CorMons organized on 1-3 December 2020, for IMAP Common Indicator 22 (beach marine litter), a Baseline Value for the Mediterranean has been proposed and updated and is equal to 329 item/100 m (UNEP/MED WG.482/23). The beach litter baseline proposed by 19th Ordinary Meeting of the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols (Athens, Greece, 9-12 February 2016) was 450-1400 items/100 m. In addition, for IMAP Common Indicator 22 (beach marine litter), the proposed Threshold Value is 59 items/100 m. For the other CIs of EO10 baseline values and thresholds cannot be defined due to insufficient data available.

107. According to the updated reporting sheets uploaded by MSs before September 2013, the reports prepared for DG ENV by Milieu Ltd (consultant's reports) for the article 12 assessment and Palialexis et al (2014) report, as well as MEDCIS Deliverable D1.1, the assessment criteria per Mediterranean EU MS were reviewed. It must be noticed that the different nature of the assessed descriptors creates a wide heterogeneity in the level of detail of the information made available, the appropriate methodologies, and the kind of outcomes expected.

108. Eutrophication (MSFD Descriptor D5, relevant to IMAP EO5) is a well-known pressure that impacts marine ecosystems and its effects on species, communities and ecosystems have been extensively studied. Even though several EU policies (WFD, UWWTD, ND) address eutrophication in marine ecosystems, MSFD does it in a wider spatial scale including both direct and indirect effects. RSCs have implemented their own methodological approaches for eutrophication assessment (for example HELCOM HEAT, OSPAR COMMON PROCEDURE, TRIX for UNEP/MAP5, BEAST for Black Sea Convention), however all methods include Chlorophyll-a (Chl-a) and its threshold values due to the WFD established ones, but differ in the way additional indicators are combined per criteria. In Mediterranean however a low level of methods' integration is observed within CPs of Barcelona Convention (UNEP/MAP) that are EU MSs. For Chl-a (CI14) the frequency of using this assessment criterion for EO5 presents values ranging from 81-100%, whereas for CI13 (nutrients) the most common used indicator is DIN (81-100%) and the less common are DON

[21]UNEP/MAP (2015). UNEP(DEPI)/MED WG.420/Inf.10. Final Report of the Informal Online Working Group on Biodiversity and NIS

[22] Considering also the Commission Decision 229 of 12 February 2018 establishing pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise and repealing Commission Decision 2013/480/EU

[23] UNEP/MAP (2015). UNEP(DEPI)/MED WG.417/Inf.15. Report of the online groups on eutrophication, contaminants and marine litter

(Dissolved organic nitrogen) and POC (Particulate Organic Carbon) with a using frequency from 21-40% and N/Si ratio with 0-20%.

109. MSFD descriptors D8 and D9 (relevant to IMAP EO9) are closely linked and have therefore been addressed together, throughout this document. Taking into consideration the data and assessments carried out within the WFD context, together with the approaches followed by the Regional Seas Conventions (RSCs), it would be expected that Member States (MSs) would be able to provide comprehensive, comparable and consistent assessments as well as Good Environmental Status (GES) definitions and environmental targets for those two descriptors as a part of the earliest stages of MSFD implementation respectively for EO9 within IMAP implementation. However, most assessments have been carried out for legacy pollutants, such as toxic metals (Hg, Cd, and Pb), PCBs, PAHs, lindane, DDT metabolites, TBT, and HCB, while very few countries have reported on other priority and emerging pollutants. WFD Priority Substances (PS) constitute an important pollution parameter, as they are means to assess the chemical quality of water bodies up to 12 nautical miles from the straightened coastline (CI17). It can be found that, although very limited for some of them, there are data for all PS and certain other pollutants listed in Annex I of the EQS Directive (2008/105/EC). Only few Mediterranean MSs have not considered the issue of biological effects (CI18) when reporting on articles 8, 9 and 10 of the MSFD. Also, the issue of acute pollution events (CI19) has not been considered by a few MSs, especially regarding impacts, since many focused on the quantification and trends of number of spills and illegal discharges and amount of substances released, than impacts. Regarding contaminants in sea food (CI20), the information available revealed a high heterogeneity, as much in the substances and the species analyzed as in the regulatory levels considered for the assessments, even though the limits established in the Regulation (EC) No. 1881/2006 have been the most commonly mentioned.

110. Most CPs that are Mediterranean EU MSs have reported on level of ML in the coastline (CI22) and the most common unit was items/100m, as well as for ML in seafloor (CI23), though not all reported for seawater. Another indicator (CI24) most taken into account by all MSs in the Mediterranean region was sea turtle (Caretta caretta), though several MS have claimed lack of data and knowledge.

111. Upgrading or setting the baselines and threshold values for the Mediterranean Sea in the context of IMAP is an ongoing process. Detail information on their present status is provided in UNEP/MED WG.492/11 and UNEP/MED WG.492/12 that are submitted to present Meeting.

112. After setting/upgrading the threshold values, a decision rule is needed on how to assess GES on optimal spatial scale of assessment. As stated in UNEP/MAP (2019 b) and recommended by the EU MSFD (SWD (2020) 62 final), it is considered more appropriate, to define the proportion of the assessment area that needs to achieve the threshold value in order to consider the assessment area in GES. For example, if for a specific parameter 95% of stations sampled in an assessment area get values below threshold then the area is considered in GES. The value of the proportion, whether it will be 95% or lower is considered the decision rule.

5.2 Methodologies for Aggregation-Integration of CIs within and across EOs

113. This section describes methods that can be applied to aggregate CIs within EO5, EO9 and EO10 towards an assessment of GES for an assessment area. Different methodologies can be applied for aggregating CIs, which vary, amongst others, in the way the outliers influence the aggregated value. In all cases individual elements/parameters within a CI should be compared against ‘thresholds’ before aggregation methods are applied, as stated previously. The choice of the most appropriate aggregation method is critical and is dependent on the type of the EO whether it is related to pressure/impact or state.

114. Aggregation methods should ensure that information within an EO is not lost so that progress towards GES as well as the effectiveness of measures can be followed (Caroni et al. 2013, Borja et al., 2014). There are several aggregation methods proposed in the literature. Usually these combine a methodology for the aggregation of the information from the parameter level to higher levels of CIs and EOs and a decision rule for the assignment of GES on the appropriate spatial scale. For aggregating CIs within the same EO it is important that all CIs have the same level of maturity and that sufficient monitoring data are available.

115. The methods should allow for transparency of the various steps of aggregation-integration. This means that details on the assessment results which are relevant for management purposes can be unfolded. Needs and options are specific for the Ecological Objectives and Common Indicators. In UNEP/MAP (2019b), the most important features that need to be retained in the assessment outputs are outlined as follows.

- Number or percentage of assessed elements failing/meeting threshold values/good status;

- Distinction between elements accessible to management and those that are not (e.g. banned legacy contaminants vs. contaminants in use);
- Distinction between matrices where this helps addressing management;
- Expression of distance to the threshold value/good status in order to provide an insight into the magnitude of the problem and an indication of progress between IMAP cycles. Options depend on the indicators and may include bar chart presentations of the assessment values against threshold, possibly normalized on a scale 0–1 or differentiated classification on both sides of the good/not good boundary.

a) UNEP/MAP methodologies for assessment of the eutrophication and contaminants` status of the Mediterranean Sea as provided in 2017 MED QSR

116. The methodology for eutrophication assessment as provided in 2017 MED QSR, as well as for 2019 updated assessments of the eutrophication status of the Mediterranean Sea24 is based on coastal water types (reference conditions) and boundaries for chlorophyll a in the Mediterranean Sea (i.e. CI14), as agreed in Decision 22/7 (COP 18). The methodology applied for assessment of the contaminants of the Mediterranean Sea in 2017 MED QSR, as well as for 2019 updated assessments, is aligned with the below approach of OSPAR. The methodology was based on the calculation of the percentages of stations (i.e. units) with levels are below or above the BACs and above environmental criteria (ca. ECs and ERLs); accordingly that were mapped for additional interpretations.

117. As explained above, the coastal water types reference conditions and boundaries for chlorophyll-a in the Mediterranean were agreed and adopted in Decision 22/7 (COP 18). The methodology for eutrophication assessment as provided in 2017 MED QSR, as well as for 2019 updated assessments of the eutrophication status of the Mediterranean Sea25 is based on coastal water types (reference conditions) and boundaries for chlorophyll a in the Mediterranean Sea (i.e. CI14), as agreed in in Decision 22/7 (COP 18). However, due to the lack of new data and not defined reference conditions and boundaries for key nutrient concentrations in water column, the assessment could not be performed (i.e. CI13) yet, only general comments were applied. The main statistical analysis is based on the coastal water typology criteria and settings derived from the analysis of influence of freshwater inputs as the main nutrient drivers. These criteria were applied on the data available for the Mediterranean through the MED POL Database, without any integration on the EO level and/or on spatial assessment scales. For the presentation of the data Box and Whisker plots are used. Information contained in the plot are H spreads (interquartile range - the absolute value of the difference between the values of the two hinges) and fences that define outside and far outside values.

118. Present efforts are aimed at further advancement of these assessment methodologies in order to ensure i) interrelations between CIs of EO 5 respectively EO9, as well as with CIs of other EOs, including well established interrelations of impacts of pressures and state of marine environment; ii) application of integration and aggregation rules for an integrated GES assessment scheme based on actual monitoring data for EO5, EO9 and EO10; iii) application of the criteria of assessment within aggregation of assessment findings at optimally nested scales of assessment that are built from scales of monitoring by applying relevant methodological approach, as elaborated above; iv) quantitative expression of assessment findings against GES achievement in considered area of assessment.

b) The ICES/OSPAR approach for integrated assessment of contaminants

119. Like the approach followed in 2017 MED QSR, a multi-step aggregation scheme is used by ICES/OSPAR (Vethaak et al., 2015). It is based on a further aggregation and integration between CIs on the EO level and on spatial assessment scales. This approach could be tested for EO10 as well.

120. Several advantages of this approach can be singled out: it is transparent, i.e. detailed information per parameter is not masked; can be easily applied to areas with limited data availability; it is based on simple calculations that can be carried out in excel. Disadvantages of this method include the inability to provide assessments across all EOs, especially across clusters, as well as difficulties to process large data sets.

121. The 5-step integrated assessment framework for hazardous substances ICES/OSPAR (Vethaak et al., 2015) is provided as follows. The first two steps have been already adopted by previous IMAP methodology

[24] UNEP/MAP (2019d). (UNEP/MED WG.463/Inf.6). Updated Thematic Assessments of the Eutrophication and Contaminants Status in the Mediterranean Marine Environment, as a Contribution to the 2019 State of Environment and Development Report (SoED)

[25] UNEP/MAP (2019d). (UNEP/MED WG.463/Inf.6). Updated Thematic Assessments of the Eutrophication and Contaminants Status in the Mediterranean Marine Environment, as a Contribution to the 2019 State of Environment and Development Report (SoED)

for EO9 assessments. The first step is to check measured parameters against thresholds for a specific matrix following the 'traffic light' system and classified with a score/ color scale depending on whether the value exceeds BAC or EAC (OSPAR, 2008). The second step is the aggregation of parameters by category (e.g. TEs, OC, Effects) and by matrix (sediment, biota) for a given site using the percentage contribution of scores/color classes in each aggregation level. The third step is the aggregation of the percentage contribution of scores/color classes across matrices (sediment, biota) by parameter for a given site. The fourth step is the spatial assessment across multiple sites (i.e. assessment scales). This can be done at multiple levels (aggregation of data at the national, subdivision or subregion levels) and in different ways to express both the overall assessment of proportion of parameters (across all matrices) exceeding the 'thresholds' (approach A) and by parameter for the assessment area showing the proportion of sites assessed in the region that exceed the 'thresholds' (approach B). The final fifth step corresponds to the overall assessment for contaminants for a specific assessment area.

122. The proportion of all parameters across all sites that exceed the threshold can be used as a decision rule for the purposes of an overall assessment, and it is proposed that a simple threshold figure (e.g. 95% < 'threshold') is used to determine whether or not GES for the MSFD Descriptor 8, which corresponds to IMAP - EO9, is met in the assessment. The method defines also the degree of uncertainty in the assessments by assigning a priori and in a semiquantitative way, five degrees of confidence. These are related to the information included in the assessment (i.e. amount of chemical data, number of matrices monitored and number of biological effects measurements). By accompanying assessments with the degree of uncertainty, comparisons of assessment results between areas/countries/regions that have measured different parameters become more transparent. An example of this methodology successfully applied in a Mediterranean regime is reported by Martinez-Gomez et al., 2015.

Figure 4A: Integration of information based on a three colour (blue, green and red) classifications of measurements of contaminant concentrations and their effects. Red classification indicates that the Environmental Assessment Criteria (EAC) is exceeded, blue indicates compliance with the Background Assessment Concentration (BAC), whereas green indicates concentrations or levels of effects are between the BAC and EAC.

8.1 (Step 1): Illustration of classification of measurements of contaminants and their effects by matrix for a specific site;
8.2 (Step2): Integration across determinants within matrices for a given site;
8.3 (Step3): Integration of matrices by determinant category for a given site;
8.4A (Step 4): Integration of determinants across sampling sites within an assessment region;
8.4B (Step 4): Integration of matrices across sampling sites by determinant category within an assessment region.
8.5 (Step 5): Integration of determinants across sampling sites, matrices, and determinants within an assessment region.

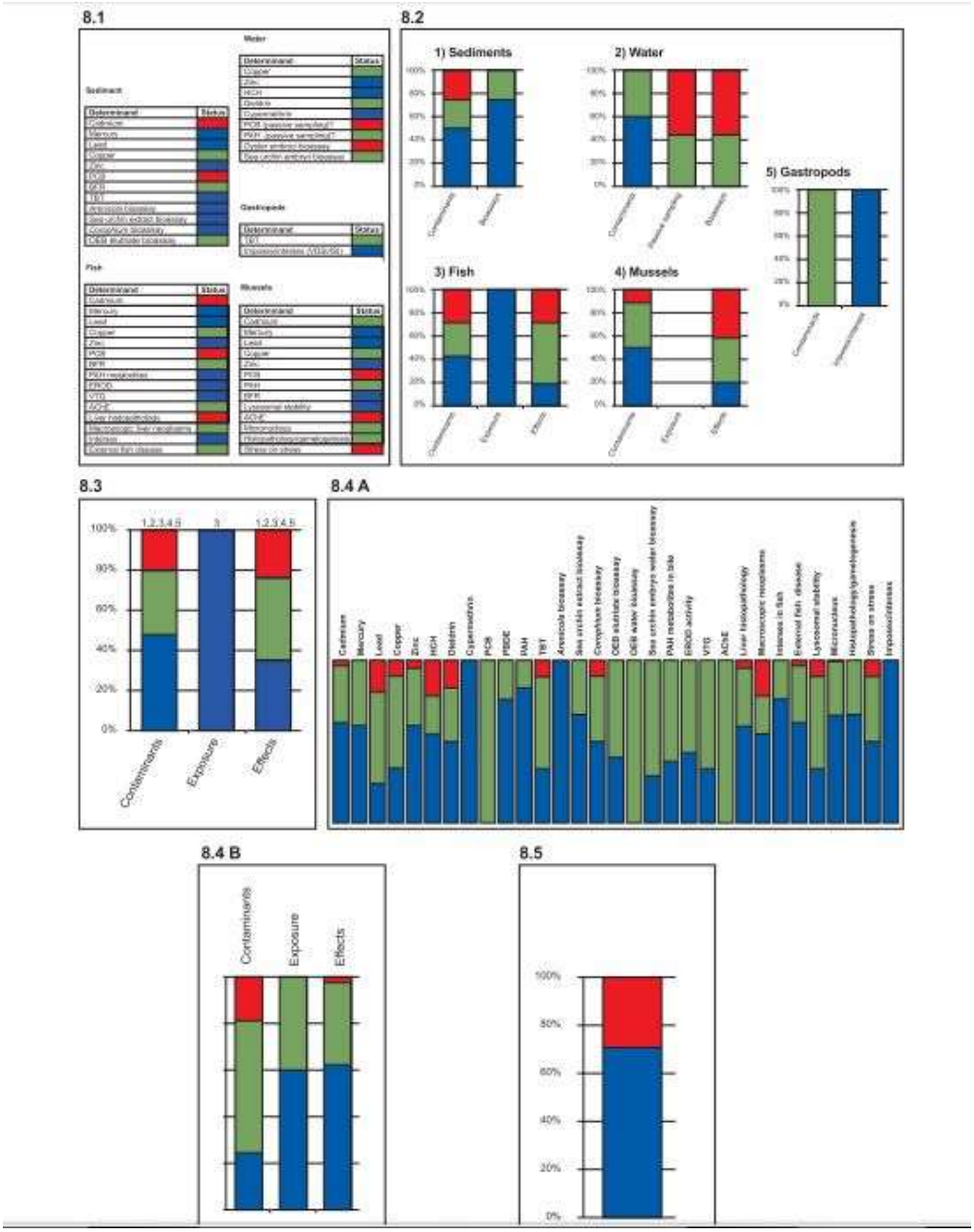
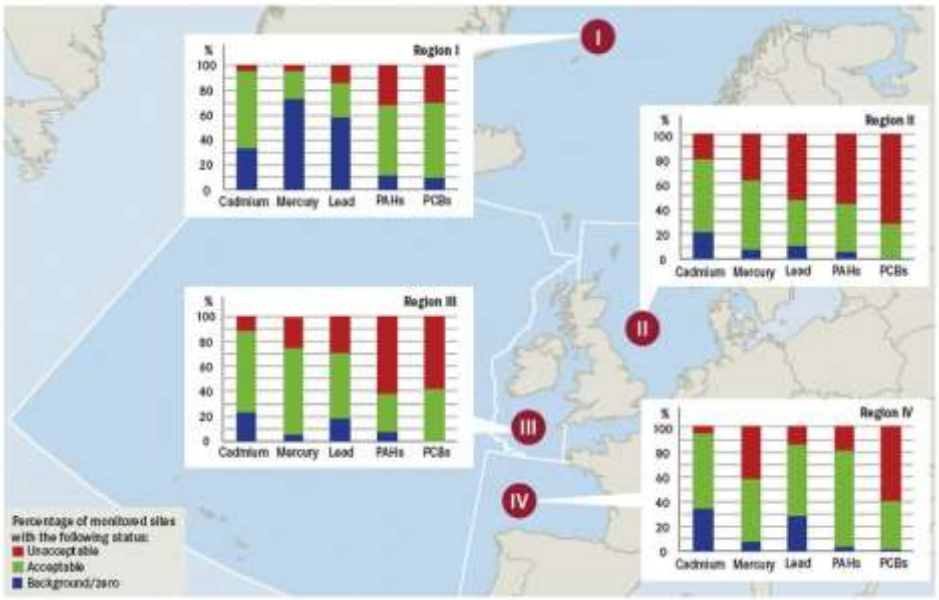

8.1
Water
Determinand
Status
Copper
Zinc
HCH
Dieldrin
Cypermethrin
PCR (passive sampler/DT
PCR (passive sampler/HT
Oyster embryo bioassay
Sea urchin embryo bioassay
Sediment
Determinand
Status
Cadmium
Mercury
Lead
Copper
Zinc
PCB
BHC
DBT
Amphipod bioassay
Sea urchin extract bioassay
Corophium bioassay
OEB elutriate bioassay
Gastropods
Determinand
Status
TBT
Imposex/stress (VDSI/RI)
Fish
Determinand
Status
Cadmium
Mercury
Lead
Copper
Zinc
PCB
BHC
PAH metabolites
EROD
VTG
AChE
Liver histopathology
Micronuclei/ nuclear abnormalities
Intersex
External fish disease
Mussels
Determinand
Status
Cadmium
Mercury
Lead
Copper
Zinc
PCB
PAH
BHC
Lysosomal stability
AChE
Micronucleus
Histopathology/genotoxicity
Stress on stress
8.2
1) Sediments
2) Water
3) Fish
4) Mussels
5) Gastropods
Contaminants
Exposure
Effects
8.3
1,2,3,4,5
3
1,2,3,4,5
100%
80%
60%
40%
20%
0%
Contaminants
Exposure
Effects
8.4 A
Cadmium
Mercury
Lead
Copper
Zinc
HCH
Dieldrin
Cypermethrin
PCB
PBDE
PAH
TBT
Amoscole bioassay
Sea urchin extract bioassay
Corophium bioassay
OEB elutriate bioassay
OEB water bioassay
Sea urchin embryo water bioassay
PAH metabolites in bile
EROD activity
VTG
AChE
Liver histopathology
Micronuclei/ nucleus
Intersex in fish
External fish disease
Lysosomal stability
Micronucleus
Histopathology/genotoxicity
Stress on stress
Imposex/stress
8.4 B
Contaminants
Exposure
Effects
8.5
100%
80%
60%
40%
20%
0%

Figure 4B: Representation of the 5-step aggregation approach for contaminants in the 4 assessment areas (Subregions) of the N-E Atlantic & the North Sea (OSPAR Commission).

57.
58.



c) The CHASE tool for Contaminants and HEAT tool for Eutrophication

123. The Chemical Status Assessment Tool (CHASE) and the HELCOM Eutrophication Assessment Tool (HEAT) have been specifically developed for the integrated assessment of the chemical and eutrophication status by the HELCOM as two of the components of the HOLAS ("Holistic Assessment of Ecosystem Health Status") tool. It has been applied by the Baltic States for the requirements of both the WFD and the MSFD.

124. The CHASE tool integrates data on hazardous substances in water, sediments and biota as well as bio-effect indicators. It is based on a substance- or bio-effect-specific calculation of a 'contamination ratio' being the ratio between an observed concentration and a threshold value. Values <1.0 indicate areas potentially 'unaffected', while values >1.0 indicate areas potentially 'affected'. These ratios are combined within matrices, i.e. for water, sediment and biota and for biological effects. The overall assessment uses the one out all out (OOAO) rule with regard to each matrix (Andersen et al., 2016).

125. When using the HEAT tool in order to produce the overall eutrophication assessment, core indicator results are grouped into three "criteria" as used under the MSFD and described in the Commission Decision (2010/477/EU): 1. Nutrient levels, 2. Direct Effects, 3. Indirect Effects. The criterion 'nutrient levels' comprises of 10 nutrient indicators, though all of them are not used together in any of the assessment units. Direct effects include the indicators chlorophyll-a concentration, Secchi depth, phytoplankton biovolume and percentage of perennial macroalgal species. Indirect effects include three shallow water oxygen indicators, deep bottom oxygen debt, nine macro-vegetation indicators and seven macro-zoobenthos indicators. Eutrophication status is assessed by the three criteria described above. The criteria-specific eutrophication status is calculated as a weighted average of the eutrophication ratio of each indicator within the criteria. The weight is evenly distributed, unless otherwise justified. The lowest criteria-specific eutrophication determines the overall eutrophication status (one-out-all-out approach) of each assessment unit. The data product may be aggregated at two alternative levels: i) Large scale - spatial: HELCOM assessment unit, following the HELCOM sub-division into 17 open sub-basins and 42 coastal areas ii) Small scale - spatial: HELCOM 20K grid. The spatial aggregation using HELCOM assessment units (large scale) is particularly suitable for indicator information such as cyanobacteria indicator and spring bloom indicator. The 20K grid size is suitable for chlorophyll-a and Secchi disk depth estimates.

d) The NEAT tool

126. The NEAT tool is a further development of the HOLAS tool. NEAT is a structured, hierarchical tool for making marine status assessments (Berg et al., 2017; Borja et al., 2016), and freely available at www.devotes-project.eu/neat. NEAT was firstly developed to assess biodiversity status of marine waters under the MSFD and since then has been used to assess different ecosystem components and geographical areas. NEAT uses a combination of high-level integration of habitats and spatial units and an averaging approach, allowing for specification on structural and spatial levels, applicable to any geographical scale. The analysis provides an overall assessment for each case study area and a separate assessment for each of the ecosystem components included in the assessment. The final value has an associated uncertainty value, which is the probability of being determinative in a certain class status (GES/non-GES, See UNEP/MED 492/Inf.9) (Uusitalo et al., 2016).

127. Essentially, the final assessment value is calculated as a weighted average, where the final weights are combined with the observed indicator values. No special rules are applied, but the tool design allows assigning different aggregation rules at the various steps in the calculation of the overall assessment value. In order to assess the uncertainty in the final assessment value and thus the uncertainty of the indicator state classification, the standard error of every observed indicator value is used (Borja et al., 2016). In addition, the more data and indicators used the more robust are the outcomes.

128. During the EU funded MEDCIS project (www.medcis.eu) a main objective was to apply integrative methods to assess the environmental status, under the MSFD concept. Hence, the objective of this MEDCIS Deliverable D2.2 (Borja et al., 2018) was to use NEAT at the Mediterranean level, to assess the environmental status in an integrative way, under the MSFD, demonstrating its usefulness under different circumstances (more or less indicators per area studied, more or less ecosystem components, etc.). It was shown that: (i) it is possible to integrate data from different sources, spatial and temporal scales and from different ecosystem components into a unique value; (ii) this integration has permitted to undertake a real Ecosystem Based Management (EBM) assessment; (iii) despite the integration there is not a loss in tracking the problems that should be addressed at the indicator, ecosystem component, descriptor or smaller spatial levels; (iv) this track of the problems is clearly related with the pressures identified and the pressure index used to validate the assessment undertaken using NEAT; (v) the assessment demonstrates also the temporal changes due to the management measures taken, showing the recovery of the system in respect to the time needed for each ecosystem component and area; and (vi) all of these findings and conclusions could be very useful for managers, policy makers and scientists when deciding the method to use in assessing and communicating the environmental status under the MSFD.

129. The objective of MEDCIS Deliverable D2.2 (Borja et al., 2018) was to use NEAT Tool at the Mediterranean level, to assess the environmental status in an integrative way, under the MSFD, demonstrating its usefulness under different circumstances (more or less indicators per area studied, more or less ecosystem components, etc.).

130. As the objective was to apply an integrative method to assess the environmental status of the study area under the MSFD framework, NEAT was applied (Borja et al., 2016), a free software available at www.devotes-project.eu/neat. NEAT has been used to assess different ecosystem components and geographical areas (Uusitalo et al., 2016; Nemati et al., 2017, 2018). NEAT uses a combination of high-level integration of habitats and spatial units and an averaging approach, allowing for specification on structural and spatial levels, applicable to any geographical scale (Uusitalo et al., 2016). The analysis provides an overall assessment for each case study area and a separate assessment for each of the ecosystem components included in the assessment. The final value has an associated uncertainty value, which is the probability of being determinately in a certain class status (GES/Not CES) (Uusitalo et al., 2016). This uncertainty was determined by the standard error linked to the indicator values. Based on these simulations, NEAT determines how often the sampled value falls into each of the five classes, and this distribution is reported. Therefore, the standard error values assigned to the indicators play a major role in the uncertainty associated with the final assessment result. This emphasizes the importance of careful evaluation of the standard deviation, particularly with indicators that have a high weight in the assessment.

131. With regards to the MSFD Descriptors evaluation, Marine Reporting Units (MRUs) are distinguished at the level of subdivision of (sub)region (dependent of whether subregions are distinguished) (see para 85).

132. NEAT was applied to Saronikos Gulf (Pavlidou et al., 2019) as pilot study by testing different SAUs (Spatial Assessment Units), ecological components and indicators in the software. NEAT is a step forward

compared to other assessment systems (Borja et al., 2016), ensuring a transparent implementation of aggregating various indicators in a comparable and systematic way. The main principles of NEAT are:

- **Indicators**: they constitute the basis of the assessment. NEAT integrates an indicator catalogue (Teixeira et al., 2016) as a source for choosing predefined indicators for the biodiversity assessment. However, the tool is not limited to those indicators; it allows the addition of as many indicators as required, not only related to biodiversity, but any kind of indicator, specific to each assessment performed (e.g. eutrophication, organic pollution, etc.).
- **Weighting and hierarchies**: the central principle in the NEAT method is a hierarchical, nested structure of SAUs and habitats. Thus, it avoids the dominance of certain indicators or habitats or SAUs by using a proper weighting procedure, which considers what information is available for different real spatial scales. That is, each indicator is related to a specific ecosystem component (e.g. fish), which lives in a certain habitat (e.g. water column), and information has been collected for a specific area or SAU (e.g. Saronikos Gulf). Thus, no bias is introduced into the assessment by the choice of the indicators.
- **Aggregation**: in order to aggregate indicators, they are all normalized into a scale of 0 to 1, independently of their original scale. Specific boundaries of the indicators (e.g. boundary between moderate and good status) are also normalized. By default, aggregation is done across all indicators belonging to a SAU. However, NEAT is designed to do aggregations to any other entity. For example, the method can be used to aggregate all indicators of a SAU and show the status divided among the different ecosystem components of the SAU.
- **NEAT value**: the outcomes of the aggregation are visualized into a number (NEAT value) and a colour, which corresponds to the status (i.e. high, good, moderate, poor and bad). This NEAT value is obtained for the whole assessed area, but can be visualized in different forms. For example, it is possible to visualize how the information from the different ecosystem components (e.g. fish, phytoplankton, etc.) has contributed to the assessment, or how the information available to the different areas contributes to the overall assessment.
- **Confidence**: each NEAT value is accompanied by its quantitative estimate of the confidence of the result. This estimate is performed using the standard error (entered at the same time as the indicator value), and performance of Monte Carlo simulations, as a means to understand how this error propagates throughout the assessment.

NEAT application

133. The NEAT version 1.3 applied to a pilot case study, the Saronikos Gulf, in order to assess the environmental status of an Eastern Mediterranean marine ecosystem and test the assessment tools' performance. For doing this, the following approach was used:

- The study area has been divided into five SAUs: the industrial zone of Elefsis Bay, Psittalia (sewage outfall), the Inner Saronikos Gulf, the Outer Saronikos Gulf and the Western Basin, all of them nested within the whole Saronikos Gulf. Hence, in total six SAUs were tested.
- The area was divided into two habitat types: benthic (rocky and sedimentary) and pelagic. NEAT classifies the status of each SAU based on indicators. Each indicator is associated with an ecosystem component, which the indicator describes. In this study, nine ecosystem components were defined: Alien species, benthic fauna, benthic vegetation, fish, phytoplankton, seagrasses, mammals, sediments and the water column. A total of 24 indicators were used.
- The indicators used for this assessment represent the best available data and expertise for 8 out of 11 of the descriptors of the MSFD (i.e., D1 (biodiversity), D2 (non-indigenous species), D3 (commercially important species), D4 (food webs) D5 (eutrophication), D6 (seafloor integrity), D7 (hydrographical conditions) and D8 (contaminants)), tested in each SAU. Regarding the indicators used to assess the status of the fish ecological component in the area, they were incorporated in the biodiversity assessment tool in order to further compliment the implementation of the analysis and do not exactly constitute the suggested indicators under MSFD.
- Four types of treatments were performed: (1) assigning equal weights (Non-Weighting by SAU); (2) weighting by SAU surface area; (3) filtering by MSFD Descriptors; (4) analysing before (2000–2004) and after (2005–2016) the operation of the secondary phase of the WWTP (weighting and non-

weighting by SAU). The period after the WWTP advancement has been divided into two equal 5-year periods (2005–2010; 2011–2016), in order to investigate the evolution of the system. In this treatment only Psittalia and Inner Saronikos sub-areas were used, since only these sub-areas are impacted by sewages and similar indicators are available through the studied period. In addition, a Pressure Index was used in the study area, giving the magnitude of the anthropogenic pressures within each SAU, and has been estimated in Simboura *et al.* (2016) and Pavlidou *et al.* (2015).

Statistical analysis

134. An analysis of variance (ANOVA) was applied in order to test the statistical significance of the differences in the NEAT values overall and by each ecosystem component derived by the non-weighting analysis and the weighting by SAU analysis, in relation with the different SAUs (overall Saronikos, Psittalia, Inner Gulf) and the time periods before and after the secondary treatment (period 1: 2000–2004, period 2: 2005–2010, period 3: 2011–2016). The normality and homogeneity of variance was tested using Shapiro-Wilks and Levene's test, respectively. The analysis was performed with STATGRAPHICS CENTURION 2009, StatPoint Technologies, Inc. software. A multivariate cluster analysis (PRIMER-e v.6.1.5) was employed (square root data transformation, Bray-Curtis similarity and group average technique) to test similarities between overall NEAT results and individual ecosystem components' assessment using data from all assessment areas. In addition, a simple regression analysis was performed between the overall Saronikos Gulf NEAT value and the pressure index applied in the study area.

135. In line with above, the application of NEAT approach should be considered in the context of GES assessment based on IMAP EOs 5, 9 and 10.

5.3 Methodology for integration of assessment results within the DPSIR approach

136. In this chapter two approaches are described that aim to compare/connect the GES assessment results obtained by applying the methodology(ies) described previously, for a specific assessment area, with the known pressures/drivers already defined for this area by expert judgment.

a) The GRID/Table approach

137. Previous UNEP/MAP documents26 on cross-cutting issues elaborated the methodological approach for mapping the interrelations between sectors, activities, pressures, impacts and state of marine environment for EO5 and EO9, including the GRID/Table approach that takes into account the geographical scales for the assessment to the sub-division level. It provides the links between the IMAP CIs to specific pressures, in a tabular form for representation, using a color scale for the intensity of pressure related to each of the CIs. The color scale is based on the known pressures at source, i.e. focusing on the primary activities generating the pressure. This information comes from cross-mapping of all the anthropogenic activities with significant contribution to pressures and assessment of the intensity of their impact on marine environment based on expert judgment.

138. The above approach, however, is not related to the assessment results of GES at sea, i.e. the level of pressure in the marine environment to which the different elements of the ecosystem are subjected. Therefore, the below Table 10 provides an update of the GRID/Table approach that was elaborated in previous UNEP/MAP documents and considered a starting point towards the Med QSR 2023. Namely, the results from the GES assessments for a specific spatial unit are included in the GRID/Table. The column 'Assessment Result' in the GRID/Table denotes the assessment status for each assessment area as provided by applying the methodologies explained in 5.2. The assessment result may be given according a quality status colour scale or scale of scores. By complementing the GRID/Table with assessment a direct comparison of the environmental status to the known pressures for a specific area can be made following the DSIR approach.

139. The comparison between the GES assessment results and the known pressures by expert judgment is expected to provide a better understanding of the actual impacts of pressures on the environmental status. If disagreement appears between status result and degree of pressure, then efforts should be concentrated in order to elucidate the causes. For example, a good GES result for Hg, Cd, Pb in areas where high degree of pressure is assigned by expert judgment, may be indicative either that the relevant sectors do not relate to

[26]UNEP/MAP (2019b). UNEP/MED WG.463/7; UNEP/MED WG.467/7. Cross-Cutting Issues and Common Challenges: The Methodological Approach for Mapping the Interrelations between Sectors, Activities, Pressures, Impacts and State of Marine Environment for EO5 and EO9.

these contaminants or that successful measures are undertaken. In this way corrective actions can be initiated towards a more effective monitoring scheme, while the effectiveness of measures can be checked.

Table 10. The GRID/Table combined with the GES assessment results.

Scaled GRID pressures/impact approach	**SUB-REGIONS**	**SUB-DIVISIONS**	**Country/ National Part**	**Assessment Result**	**Coastal urbanizati**	**Industry**	**Offshore structures**	**…..**
Common Indicator x	**Western Mediterranean Sea**	North Western (NWMS)	Coastal (1 nm)	**non-GES**				
			Territorial (12 nm)	**GES**				
		Alboran Sea (ALBS)	Coastal (1 nm)	**…**				
			Territorial (12 nm)	**..**				
		Tyrrhenian Sea (TYRS)	Coastal (1 nm)					
			Territorial (12 nm)					
	Adriatic Sea	North Adriatic (NADR)	Coastal (1 nm)					
			Territorial (12 nm)					
		Middle Adriatic (MADR)	Coastal (1 nm)					
			Territorial (12 nm)					
		South Adriatic (SADR)	Coastal (1 nm)					
			Territorial (12 nm)					
	Central and Ionian Sea	Centra l (CEN)	Coastal (1 nm)					
			Territorial (12 nm)					
		Ionian Sea (IONS)	Coastal (1 nm)					
			Territorial (12 nm)					
	Aegean and Levantine Seas	Aegean Sea (AEGS)	Coastal (1 nm)					
			Territorial (12 nm)					
		Levantine (LEVS)	Coastal (1 nm)					
			Territorial (12 nm)					

b) The Framework for Vulnerability Assessment

140. There are several methodological approaches that may be used for mapping the distribution of pressures and assessment of their impacts over different ecosystem components (species groups, pelagic or benthic habitats), with defined quality threshold values (i.e. categorizations and values assignment). An example of such approach was piloted in Boka Kotorska Bay (Montenegro) through the CAMP initiative, under the guidance of UN Environment/MAP - PAP/RAC. It included interrelations between the IMAP Common Indicators, coastal vulnerability assessment and management measures, including Marine Spatial Planning (MSP).

141. This methodological approach includes the following four main steps: 1) recording status of marine environment characteristics (i.e. habitats, species groups, etc.) and natural and anthropogenic pressures (selected based on the main activities in terms of pressures as provided by ICZM Protocol and other Barcelona Convention`s Protocols) affecting the marine ecosystems; 2) (i) assessing values of each environmental component of assessment areas by calculating value index expressed as a combination of values of relevant state IMAP Common Indicators/parameters (e.g. protection status of areas/habitats, distribution and representativity of species, etc.); (ii) assessing values of impacts over each ecosystem component of assessment areas by calculating impact index expressed as a combination of values of relevant pressure IMAP Common Indicators/parameters (e.g. eutrophication (measured chl-a/ TRIX index against boundary values); contaminates (measured concentrations of pollutants against thresholds); extent of built-up areas (location and extent of the habitats impacted directly by hydrographic alterations; length of coastline subject to physical disturbance due to the influence of manmade structures) etc.); 3) assessing vulnerability of the assessment area by determining adaptive capacity of the assessment area through combination of indexes of value and impacts including use of modelling tools to complement real time monitoring data; 4) defining the measures for protection, rehabilitation and optimisation of ecosystem services in line with assessed vulnerability of the assessment area. Further adjustment of the vulnerability assessment and mapping of distribution of pressures and impacts over different ecosystem components, could be considered as to ensure use of this methodology in the context of GES assessment.

Figure 5: Scheme for vulnerability assessment

Annex I

References

UNEP/MAP (2020). UNEP/MED WG 482/28. Comparative analysis of MSFD and IMAP implementation

UNEP/MAP (2019). UNEP/MED WG.463/8. Approaches on Scales of Monitoring for Common Indicators related to pollution.

UNEP/MAP (2019a). UNEP/MAP 467/9. Data Standards and Data Dictionaries for Common Indicators related to Pollution and Marine Litter.

UNEP/MAP(2019b). UNEP/MED WG.463/7; UNEP/MED WG.467/7. Cross-Cutting Issues and Common Challenges: The Methodological Approach for Mapping the Interrelations between Sectors, Activities, Pressures, Impacts and State of Marine Environment for EO5 and EO9.

UNEP/MAP (2019 c). UNEP/MAP WG.467/5. IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21; New proposal for Candidate Indicators 26 and 27.

UNEP/MAP (2019 d). (UNEP/MED WG.463/Inf.6). Updated Thematic Assessments of the Eutrophication and Contaminants Status in the Mediterranean Marine Environment, as a Contribution to the 2019 State of Environment and Development Report (SoED)

UNEP/MAP (2018). National IMAP-based monitoring programmes of Algeria, Bosnia and Herzegovina, Egypt, Israel, Lebanon, Libya, Montenegro, Morocco and Tunisia.

UNEP/MAP (2016). Decision 22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria" (COP18).

UNEP/MAP (2016a). UNEP(DEPI)/MED WG.427/Inf.3. Background to the Assessment Criteria for Hazardous Substances and Biological Markers in the Mediterranean Sea Basin and its Regional Scales these revised assessment criteria

UNEP/MAP (2015). UNEP(DEPI)/MED WG.420/Inf.10. Final Report of the Informal Online Working Group on Biodiversity and NIS; UNEP(DEPI)/MED WG.417/Inf.15. Report of the online groups on eutrophication, contaminants and marine litter

UNEP/MAP (2011). (UNEP(DEPI)/MED WG.363/Inf.21. UN Environment/MAP 2011 Initial Integrated Assessment.

Andersen, J. H., Murray, C., Larsen, M. M., Green, N., Høgåsen, T., Dahlgren, E., et al. (2016). Development and testing of a prototype tool for integrated assessment of chemical status in marine environments. *Environ. Monit. Assess.*, 188: 115. doi: 10.1007/s10661-016-5121-x.

Berg, T., Murray, C., Carstensen, J., and Andersen, J. H. (2017). NEAT – Nested Environmental Status Assessment Tool - Manual Version 1.3. DEVOTES project.

Borja A., Elliott M., Andersen J.H., Berg T., Carstensen J., Halpern B.S., Heiskanen A.-S., Korpinen S., Lowndes J.S.S., Martin G. and Rodriguez-Ezpeleta N. (2016) Overview of Integrative Assessment of Marine Systems: The Ecosystem Approach in Practice. *Front. Mar. Sci*., 3: 20. doi: 10.3389/fmars.2016.00020.

Borja A., Prins T.C., Simboura N., Andersen J.H., Berg T., Marques J.-C., Neto J.M., Papadopoulou N., Reker J., Teixeira H. and Uusitalo L. (2014) Tales from a thousand and one ways to integrate marine ecosystem components when assessing the environmental status. *Front. Mar. Sci*., 1:7 2. doi: 10.3389/fmars.2014.00072

Borja, A., J.M. Garmendia, I. Menchaca, Y. Sagarmínaga, A. Uriarte, A. Pavlidou, N. Simboura, Ch. Zeri, S. Gorjanc, Š. Koren, K. Klančnik, J. Francé, B. Mavrič, M. Orlando-Bonaca, F. Galgani (2018). An assessment of the environmental status of the Mediterranean. MEDCIS Project, DELIVERABLE D2.2, December 2018, 34 p.

Carbonell, A., Rios, B., Torres, A. P., Deudero, S., Alemany, F., Bellas, J., Dall' Angelo, C., Campostrini, P., Klancnik, K., Gorjanc, S., Koren, S., Mavric, B., France, J., Pastres, R., Marcomini, A., Basset, A., Zeri, C., Dassenaki, M., Paramana, T., Streftaris, N., Giannoudi, L., and Pagou, K. (2018). 'Report on proposals for optimizing existing MSFD related monitoring plans in the Mediterranean, focusing on NIS and Marine litter. MEDCIS Project, Deliverable 3.5', December 2019, 87 p.

Caroni, R., W. Bund, R.T. Clarke and R.K. Johnson (2013). Combination of multiple biological quality elements into waterbody assessment of surface waters. *Hydrobiologia*, 704: 437-451.

Dinter W.P. (2001). Biogeography of the OSPAR Maritime Area. Bundesamt für Naturschutz Federal Agency for Nature Conservation, Bonn, Germany, 167 pp.

Gubbay, S. (2014). A review of the use of biogeography and different biogeographic scales in MPA network assessment. JNCC Report No. 496.

Martínez-Gomez, C., Fernandez, B., Robinson, C.D., Campillo, J., Leon, V.M., Benedicto, J., Hylland, K., Vethaak, A.D. (2015). Assessing the good environmental status (GES) of the Cartagena coastal zone (W Mediterranean) using an integrated framework of chemical and biological effect data: a practical case study. *Marine Environ. Res*. http://dx.doi.org/10.1016/j.marenvres.2016.04.008

Nemati, H., Shokri, M.R., Ramezanpour, Z., Ebrahimi Pour, G.H., Muxika, I., Borja, Á. (2017). Using multiple indicators to assess the environmental status in impacted and non-impacted bathing waters in the Iranian Caspian Sea. *Ecol. Ind.*, 82: 175–182.

Nemati, H., Shokri, M.R., Ramezanpour, Z., Ebrahimi Pour, G.H., Muxika, I., Borja, Á. (). Sensitivity of indicators matters when using aggregation methods to assess marine environmental status. *Mar. Pollut. Bull*., 128: 234–239.

Palialexis A., Tornero V., Barbone E., Gonzalez D., Hanke G., Cardoso A.C., Hoepffner N., Katsanevakis S., Somma F., Nikolaos Zampoukas N. (2014). In-Depth Assessment of the EU Member States' Submissions for the Marine Strategy Framework Directive under articles 8, 9 and 10. EUR – Scientific and Technical Research series – ISSN 1831-9424, ISBN 978-92-79-35273-7, doi: 10.2788/64014, Luxembourg: Publications Office of the European Union, 149 pp.

Pavlidou, A., Simboura, N., Rousselaki, E., Tsapakis, M., Pagou, K., Drakopoulou, P., Assimakopoulou, G., Kontoyiannis, H., Panayotidis, P. (2015). Methods of eutrophication assessment in the context of the water framework directive: Examples from the Eastern Mediterranean coastal areas. *Cont. Shelf Res*., 108, 156–168.

Pavlidou A., Simboura N., Pagou K., Assimakopoulou G., Gerakaris V., Hatzianestis I., Panayotidis P., Pantazi M., Papadopoulou N., Reizopoulou S., Smith C., Triantaphyllou M., Uyarra M.C., Varkitzi I., Vassilopoulou V., Zeri Ch., Borja A. (2019). Using a holistic ecosystem-integrated approach to assess the environmental status of Saronikos Gulf, Eastern Mediterranean. *Ecological Indicators*, 96: 336–350.

Simboura, A., Pavlidou, J., Bald, M., Tsapakis, K., Pagou, Ch., Zeri, A., Androni and P. Panayotidis. (2016). Response of ecological indices to nutrient and chemical contaminant stress factors in eastern Mediterranean coastal waters. *Ecol. Ind*., 70: 89–105.

SWD 62 final (2020) COMMISSION STAFF WORKING DOCUMENT Background document for the Marine Strategy Framework Directive on the determination of good environmental status and its links to assessments and the setting of environmental targets Accompanying the Report from the Commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive (Directive 2008/56/EC).

Teixeira, H., Berg, T., Uusitalo, L., Fürhaupter, K., Heiskanen, A.-S., Mazik, K., Lynam, C., Neville, S., Rodriguez, J.G., Papadopoulou, N., Moncheva, S., Churilova, T., Krivenko, O., Krause-Jensen, D., Zaiko, A., Verissimo, H., Pantazi, M., Carvalho, S., Patrício, J., Uyarra, M.C., Borja, A. (2016). A catalogue of marine biodiversity indicators. *Front. Mar. Sci.*, 3. https://doi.org/10.3389/fmars.2016.00207.

Uusitalo, L., Blanchet, H., Andersen, J., Beauchard, O., Berg, T., Bianchelli, S., *et al*. (2016). Indicator-based assessment of marine biological diversity –lessons from 10 case studies across the European Seas. *Front. Mar. Sci*., 3: 159.doi: 10.3389/fmars.2016.00159

Vethaak, A.D., Davies, I.M., Thain, J.E., Gubbins, M.J., Martínez-Gomez, C., Robinson, C., Moffat, C.F., Burgeot, T., Maes, T., Wosniok, W., Giltrap, M., Lang, T., Hylland, K. (2015). Integrated indicator framework and methodology for monitoring and assessment of hazardous substances and their effects in the marine environment. *Marine Environmental Research*, 124: 11-20.