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Meeting of the MED POL Focal Points

Athens, Greece, 24-26 May 2023

Agenda item 5: Assessment of marine and Coastal Environment:

a) **New/Updated IMAP Assessment Criteria for Nutrients, Contaminants and Marine Litter**
b) **Measures related to assessment findings of the 2023 MED QSR for Pollution and Marine Litter**

The 2023 Mediterranean Quality Status Report (QSR): The Proposal of the IMAP Pollution Cluster Chapters of the 2023 MED QSR

UNEP/MAP
Athens, 2023

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Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring

Athens, Greece, 1-2 March 2023

Agenda item 3: 2023 Mediterranean Quality Status Report (QSR) - Pollution Ecological Objectives (EO5, EO9):

The Proposal of the IMAP Pollution Cluster Chapters of the 2023 MED QSR

UNEP/MAP
Athens, 2023

Note by the Secretariat

In line with the Programme of Work and Budget for 2018-2019 adopted by the 20th Ordinary Meeting of the Contracting Parties to the Barcelona Convention (COP 20) held in Tirana, Albania; the Programme of Work and Budget for 2020-2021 adopted by the 21st Ordinary Meeting of the Contracting Parties to the Barcelona Convention (COP 21) held in Naples, Italy; the Programme of Work and Budget for 2022–2023 adopted by the 22nd Ordinary Meeting of the Contracting Parties to the Barcelona Convention (COP 22) held in Antalya, Türkiye, MED POL Programme prepared a Proposal for 2023 MED QSR Pollution Chapters based on the thematic assessments provided for IMAP Common Indicators 13, 14, 17, 18, 20 and 21presented in the respective information documents prepared for this meeting. The present proposal also included a thematic assessment for IMAP Common Indicator 19 provided by REMPEC.

In line with the Decision IG.23/6 of COP 20 related to the 2017 Mediterranean Quality Status Report (MED QSR), and Decision IG.24/4 of COP21 providing the 2023 MED QSR Roadmap implementation (Naples, Italy, December 2019), UNEP/MAP–MED POL implemented activities to address key priority needs towards a DPSIR-based GES assessment of the 2023 MED QSR. This resulted in the preparation of the present Proposal of the 2023 MED QSR Pollution Chapters by building on the following key achievements within the implementation of the 2023 MED QSR Roadmap:

a) Setting the assessment criteria i.e. upgrading BC and BAC values for IMAP Common Indicator 17, as well as EAC values for IMAP Common Indicator 20; setting the reference conditions and G/M boundary values for Chl *a*, TP, DIN in the Adriatic Sea Sub-region coastal and open (offshore) waters; proposing approaches for future upgrades of EAC values for IMAP Common Indicators 17, 18 and 20 that will take place as of 2024.

b) Setting the integration and aggregation rules for monitoring and assessment including: 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 monitoring programmes, as well as by also considering 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; 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.

c) Development, testing and implementation of the following GES and alternative environmental assessment methodologies by applying the above defined integration and aggregation rules along with the sales of assessment, the assessment criteria and the DPSIR approach within the IMAP nested scheme: i) the NEAT IMAP GES assessment methodology along the nested areas of assessment (CIs 13, 14 and 17); ii) the CHASE+ assessment methodology (CIs 13, 14 and 17); iii) the Ecological Quality Ratio (EQR) (CIs 13 and 14); iv) the simplified EQR methodology (CI 14); v) the simplified G/M assessment comparison methodology (CI 14); vi) the assessment approach for biological effects based on the use of the literature sources; vii) the assessment approach for contaminants in seafood based on the concentration limits for the contaminants regulated in EU; viii) the assessment approach for bathing water quality based on the complementary use of the assessment results as presented in the Assessment report from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020 and the assessment of monitoring data reported for IMAP; and ix) the adapted exposure index and assessment methodology as provided in the document "Setting of EU Threshold Values for impulsive and continuous underwater sound."

Despite the significance of the above-listed achievements, the lack of reported data by the Contracting Parties, as stipulated in Decisions IG.23/6 and IG.24/4, as well as the administrative and management barriers, resulted in the preparation of the thematic assessments related to the 2023 MED QSR Pollution Cluster at the level of the IMAP Pollution Cluster Common Indicators, instead of the Common Indicators level, which was foreseen to be undertaken by each Contracting Party with the view to address specific knowledge gaps as stated in the 2023 MED QSR roadmap and needs assessment (Annex V of Decision IG.24/4).

The 2023 MED QSR Pollution Cluster thematic assessments were provided per sub-division i.e. at the sub-region level, as suitable and feasible for specific Common Indicators, by applying the rules for their integration and aggregation along the IMAP nested scheme. The four Mediterranean sub-regions and related sub-divisions were set as the highest level of IMAP Spatial Assessment Units for Common Indicators of the IMAP Pollution Cluster.

The preparation of the present Proposal of the 2023 MED QSR Pollution Chapters was undertaken successively further to the conclusions and recommendations of the Meetings of CorMon on Pollution Monitoring (2-3 April 2019, 1-3 December 2020, 26-28 April 2021, 27 and 30 May 2022); Meetings of the Online Working Groups on Eutrophication and Contaminants (June 2021); Meeting of the MEDPOL Focal Points (May 2019, May, July and September 2021 -;, and Meetings of the EcAp Coordination Group (September 2019, September 2021, and July 2022) related to the technical documents on the assessment criteria, rules for integration and aggregation, the assessment methodologies and their testing in different areas of the Mediterranean. Moreover, an important contribution was provided, and an overall basis was set, during the Regional Meeting on IMAP Implementation "Best Practices, Gaps and Common Challenges" (Rome, Italy, 10-12 July 2018) which was organized in the context of applying different tools related to GES assessment.

The present Proposal of the 2023 MED QSR Pollution Cluster Chapters is submitted for the review and approval of the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring with a view of: i) its finalization for consideration of the Meeting of Integrated CorMons planned in June 2023; and ii) preparation of Section 6 related to the measures further to IMAP Pollution Cluster assessment findings for consideration of the Meeting of the MED POL Focal Points to be convened in May 2023.

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List of Abbreviations / Acronyms

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
AChE	Acetylcholinesterase
ADR	Adriatic Sea Sub-region
AEGS	Aegean Sea sub-division
AEL	Aegean and Levantine Seas Sub-region
AIS	Automated Identification System
ALBS	Alboran Sea sub-division
AM	Arithmetic mean
AZ	Assessment Zone
BAC	Background Assessment Concentrations
BaP	Benzo(a)pyrene
BC	Background Concentration
BChE	Butyrylcholinesterase
BDL	Below Detection Limit
BFCOD	7-benzyloxy-4-[trifluoromethyl]-coumarin-O-debenzyloxylase
BWQ	Bathing Water Quality
C	Concentration
CAS	Central Adriatic Sea sub-division
CAT	Catalase
CDR	Central Data Repository
CE	Carboxylesterase
CEN	Central Mediterranean Sea Sub-region
CENS	Central Mediterranean Sea sub-division
CFU	Colony forming units
CHASE+	Chemical Status Assessment Tool
Chl *a*	Chlorophyll *a*
CI	Common Indicator
COP	Conference of the Parties
CORMON	Correspondence Group on Monitoring
CP	Contracting Party
CR	Contamination Ratio
CS	Contamination Score
CW	Coastal waters monitoring zone
CWMS	Central Western Mediterranean Sea sub-division
D	Descriptor
DD	Data Dictionary
DIN	Dissolved Inorganic Nitrogen
dl	Dioxin like
DL	Detection Limit
DPSIR	Driver, pressure, state, impact, response
DS	Data Standard
dw	Dry weight

List of Abbreviations / Acronyms (continued)

EAC	Environmental Assessment Criteria
EC	European Commission
EcoQOs	Ecological Quality Objectives
EDI	Estimated daily intake
EEA	European Environmental Agency
EIONET	European Environment Information and Observation Network
EMODnet	European Marine Observation and Data Network
EO	Ecological Objective
EQR	Ecological Quality Ratio
EQS	Environmental Quality Standard
ERL	Effects Range Low
EROD	Ethoxyresorufin-O21 deethylase
ESRI	Environmental Systems Research Institute
ESRI	Environmental Systems Research Institute
ETS	Electron Transport System
EU	European Union
EWI	Estimated weekly intake
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
GES	Good Environmental Status
GFCM	General Fisheries Commission for the Mediterranean
GLY	Glycogen
G/M	Good/moderate status boundary
GM	Geometric mean
GPx	Glutathione peroxidase
GRd	Glutathione reductase
GSH	Glutathione
GST	Glutathione-S-transferase
HCB	Hexachlorobenzene
HELCOM	Helsinki Commission
HI	Total risk
HQ	Hazard quotient
ICZM	Integrated Coastal Zone Management
IE	Intestinal enterococci
IHO	International Hydrographic Organization
IMAP	Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria
INR	International Noise Register
IONS	Ionian Sea sub-division
JRC	Joint Research Centre
LDH	Lactate dehydrogenase
LEVS	Levantine Basin Sea sub-division

List of Abbreviations / Acronyms (continued)

LMS	Lysosomal Membrane Stability
LOBE	Level of Onset of Biological Effects
LPO	Lipid peroxidation
MAP	Mediterranean Action Plan
MB	*Mullus barbatus*
MDA	Malondialdehyde
MED	Mediterranean
MED POL	Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea
MED QSR	Mediterranean Quality Status Report
MedEAC	Mediterranean Environmental Assessment Concertation
MG	*Mytilus galloprovincialis*
MN	Micronucleus Assay
MP	Microplastic
MRL	Maximum residue limit
MRU	Marine Reporting Unit
MSFD	Marine Strategy Framework Directive
MSs	Member States
MT	Metallothionein
NAS	North Adriatic Sea sud-division
NEAT	Nested Environmental Status Assessment Tool
nonGES	not Good Environmental Status
NPA	Non Problem Area
NRTT	Neutral red retention time
OOAO	One Out All Out
OW	Offshore waters monitoring zone
OWG	Online Working Group
PA	Problem Area
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated dibenzo-para-dioxins
PCDD/Fs	Polychlorinated dibenzo-para-dioxins and dibenzofurans
PCDF	Polychlorinated dibenzofurans
PDBE	Polybrominated diphenyl ethers
PFAS	Per- and polyfluorinated alkyl substances
POPs	Persistent organic pollutants
PUHA	Potentially Usable Habitat Area
QSR	Quality Status Report
RC	Reference condition
SAS	South Adriatic Sea sub-division
SAU	Spatial Assessment Units
SD	Sub-division

List of Abbreviations / Acronyms (continued)

SOD	Superoxide dismutase
SoS	Stress on Stress
TEF	Toxic equivalency factor
TG	Task group
THQ	Target hazard quotient
TM	Trace metals
TP	Total Phosphorous
TYRS	Tyrrhenian Sea sub-division
UNEP	United Nations Environmental Program
VTG	Vitellogenin
WFD	Water Framework Directive
WHO	World Health Organization
WMS	Western Mediterranean Sea sub-region
ww	Wet weight

1. Key messages[1][2]

2. Background information and methodology[3]

2.1. An overall interrelationship of the scope of the 2023 MED QSR with the 2017 MED QSR

1. In the context of implementing the Ecosystem Approach Roadmap adopted by the Contracting Parties to the Barcelona Convention and its Protocols in 2008 (Decision IG.17/6), the UNEP/MAP system delivered during the biennium 2016-2017, the first ever Quality Status Report for the Mediterranean (hereinafter referred to as 2017 MED QSR, https://www.medqsr.org/). This is an assessment product based on region-wide Ecological Objectives and Common Indicators that is built upon existing data and complemented with inputs from numerous diverse sources.

2. Within the 2017 MED QSR, the assessment of initial status of marine environment related to IMAP Pollution Cluster was provided by combining i) the traffic light assessment approach i.e. comparing the concentrations of the contaminants measured at monitoring stations with the threshold values of the assessment criteria and ii) complementary use of the bibliographic data.

3. **The assessment of IMAP Common Indicators 13&14** methodology included the use of the coastal water types (reference conditions) and boundaries as agreed and adopted in IMAP Decision 22/7, for chlorophyll *a* in the Mediterranean Sea (i.e. CI14). However, due to the lack of new data and non defined reference conditions and boundary values for key nutrient concentrations in water column, the nutrients` assessment could not be performed (i.e. CI13), only general comments were provided. The main statistical analysis was based on the typology criteria. The eutrophication was assessed by relying on the classification scheme related to Chlorophyll *a* concentration (μgL^{-1}) in coastal waters as a parameter easily applicable by all Mediterranean countries based on the thresholds and reference values as provided in IMAP Decision 22 /7. For the presentation of the data, the Box and Whisker plots were used. The statistical information contained in the plot were Hspreads (interquartile range - the absolute value of the difference between the values of the two hinges) and fences that define outside and far outside values. Given lack of data reporting, satellite synoptic measurements for the estimation of chlorophyll *a*

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[1] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6: A short paragraph with the key messages for each Ecological Objective (EO), presented as a chapeau; 3-4 sentences maximum. Provide a brief description of the EO and what the assessment outcome shows. This should be a non-technical, non-scientific description for a general or policy audience.

[2] The key messages will be provided along with section 6 further to consideration of the IMAP Pollution Cluster assessment findings as presented in Sections 4 and 5.

[3] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:

- Introduction presenting the relationship of the present scope of QSR with 2017 MED QSR, i.e., related to Decisions of the Parties (e.g., IMAP, QSR, assessment studies) and the QSR roadmap
- Structure of 2023 MED QSR, based on priority themes
- Explain the combination of Common Indicator (CI) assessments *within* each theme
- CI assessments will indicate the interrelationship with other CIs, within the same EO or other EOs, as appropriate
- Assessment findings will highlight the feasibility of integration between CIs and EOs

Note:

Within the elaboration of the methodological approach used, summarise the most important elements of the good environmental status (GES) assessment/ alternative assessment methodologies applied for individual CIs / EOs (as specified below in more detail).

concentration trends were reviewed to support detection of the anomalous, local biogeochemical processes and to assess the different requirements of environmental regulations (Colella *et al.*, 2016).

4. **The assessment of IMAP Common Indicator 17** included only quantitative data on the concentrations of trace metals (Cd, Hg, Pb) in sediment, mussels (*M. galloprovincialis* and other species) and in the muscle tissue of the fish *M. barbatus.* The data were collected from the MED POL Database. The data, per matrix and station, were compared to MedBACs and MedEACs, assessed based on the traffic light system, and given a color code. The color-coded points were plotted and presented in whole Mediterranean regional maps, a separate map for each contaminant per matrix. Data for petroleum hydrocarbons (among them PAHs) and persistent organic pollutants (POPs, among them PCBs) were not sufficient for undertaking initial assessment of the marine environment within the 2017 MED QSR.

5. **The assessment of IMAP Common Indicator 18** was based on bibliographic studies and scientific documents in the Mediterranean Sea, as almost no data were available from the MED POL Database. Data from reference stations datasets were extracted (UNEP/MAP/MED POL, 2016) and used in the assessment. By relying on such available source, the integrated evaluation of the biomarkers was provided namely, evaluation of Acetylcholinesterase activity (AChE), Lysosomal membrane stability (LMS) and Micronuclei frequencies (MN) for which BACs and EACs were adopted (Decisions IG.22/7 and IG.23/6). Further, the enzyme 7-ethoxy-resorufin-O-deethylase (EROD) and Metallothionein (MT) have been also indicated for fish and mussel samples, respectively.

6. **The assessment of IMAP Common Indicator 20** was based on bibliographic studies and scientific documents in the Mediterranean Sea, as no data were available from the MED POL Database. The assessment was based, tentatively, on the statistics about the number of detected contaminants and their deviations from legal permissions in commercial fish species set by national, European and international regulations within national jurisdictional areas.

7. **The assessment of IMAP Common Indicator 21** was based on the assessment report from the European Environment Agency (EEA) on Bathing Water Quality (from 2015) that was then integrated with the assessment of monitoring data reported from Tunisia to MED POL (2014). The assessment included only 9 Contracting Parties. No sufficient updated datasets at regional scale were available from the MED POL Database.

8. Underlining the importance of the 2017 QSR preparation as the major and innovative MAP achievement, Decision IG. 23/6 on the 2017 MED QSR (COP 20, Tirana, Albania, 17-20 December 2017) pointed out several gaps and requested the Secretariat "to prepare in cooperation with the Contracting Parties through the Ecosystem Approach governance structure, in the first year of the biennium 2018-2019, a Roadmap accompanied with a Needs Assessment on how to improve data collection to address knowledge gaps and strengthen the capacities of the system (the QSR 2023 Roadmap). To this aim, priority activities needed to successfully deliver the 2023 Mediterranean Quality Status Report shall be identified for inclusion in the Programme of Work".

9. Decision IG. 23/6 on the 2017 MED QSR recommended the following directions to address several gaps and ensure successful delivery of the 2023 MED QSR:

(i) harmonization and standardization of monitoring and assessment methods;
(ii) improvement of availability and ensuring of long time series of quality assured data to monitor the trends in the status of the marine environment;
(iii) improvement of availability of the synchronized datasets for marine environment state assessment, including use of data stored in other databases where some of the Mediterranean countries regularly contribute;
(iv) improvement of data accessibility with the view to improving knowledge on the Mediterranean marine environment and ensuring that Info-MAP System is operational and continuously upgraded, to

accommodate data submissions for all the Integrated Monitoring and Assessment Programme (IMAP) Common Indicators.

10. Consistent with the Decision IG.23/6 of COP 20 related to the 2017 Mediterranean Quality Status Report (MED QSR), and Decision IG.24/4 of COP21 providing the 2023 MED QSR Roadmap implementation (Naples, Italy, December 2019), UNEP/MAP – MED POL implemented activities to address the following key priority needs towards a DPSIR-based GES assessment of the 2023 MED QSR:

1. Scale(s) of monitoring, assessment and reporting to be agreed on, to enable comparable data sets assessment;
2. Necessary methodological tools and assessment criteria to be agreed on to allow and promote integrated assessment of GES;
3. Monitoring Protocols and Data Quality Assurance and Quality Control for IMAP Common Indicators are to be made available to guide Contracting Parties;
4. National capacity and knowledge gaps are to be addressed to ensure region-wide coherence and data availability;
5. Regional partners, projects to be able to input process in a coordinate manner.

11. In setting overall basis for implementation of the above listed activities in the context of applying different tools related to GES assessment, an important contribution was provided during the Regional Meeting on IMAP Implementation: Best Practices, Gaps and Common Challenges (Rome, Italy, 10-12 July 2018).

12. Within the preparation of the 2023 MED QSR, the outputs at IMAP Pollution Cluster Common Indicators level were prepared for four Mediterranean sub-regions by considering data reported by the Contracting Parties into IMAP Information System after 2017. Despite significant development in setting the assessment criteria; GES assessment methodologies; integration and aggregation of the assessment products; monitoring procedures and sharing the best practices, a lack of data reported by the Contracting Parties, as required in Decisions IG.23/6 and IG.24/4, as well as administrative and management barriers, resulted in the preparation of the thematic assessments related to the 2023 MED QSR Pollution Cluster at the level of IMAP Pollution Cluster Common Indicators, instead at the level of Common Indicators per each Contracting Party with a view to addressing specific knowledge gaps as stated in the 2023 MED QSR roadmap and needs assessment (Annex V of Decision IG.24/4).

13. Given the lack of data reported for all IMAP Common Indicators related to pollution and eutrophication, alternative sources were also explored and put in use, as appropriate and feasible. As a result of the differences in the availability of data between the 4 subregions, several limitations were encountered in the definition of assessment criteria and the assessment of the status of marine environment.

14. The results of work and outputs related to IMAP Pollution Cluster were elaborated in line with the Programme of Works 2019-2020; 2020-2021; 2022 and 2023 adopted by COP 20; COP 21 and COP 22, further to the conclusions of the Meetings of CorMon on Pollution Monitoring that were organized on 2-3 April 2019; 1-3 December 2020; 26-28 April 2021; 27 and 30 May 2022, as well as the Meetings of the Online Working Groups on Eutrophication and Contaminants organized in June 2021, and the Meeting of MED POL Focal Points organized in May 2019 and in May, July and September 2021 respectively, and the Meetings of the EcAp Coordination Group organized in September 2019; September 2021 and July 2022. Moreover, as stated here-above, an important contribution was provided and an overall basis was set during the Regional Meeting on IMAP Implementation: Best Practices, Gaps and Common Challenges (Rome, Italy, 10-12 July 2018), in the context of applying different tools related to GES assessment.

2.2. 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

15. 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 analysis was undertaken of the current national monitoring and assessment practices of the Contracting Parties, along with other related best available knowledge and practices. As a result, the Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster (UNEP/MAP – MED POL, 2021) was prepared providing 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 monitoring programmes, as well as by also considering 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. These rules set the basis for monitoring and assessment of marine environment within the IMAP implementation both at the national and regional levels.

2.3. The rules for integration of areas of monitoring

16. The harmonization of the scales approach between the CPs was the starting point for the integration process i.e. to scale up the marine assessment to sub-divisions, followed by sub-regional and regional scales as required under IMAP. In order to support harmonization, there was a need to define Integration Rules for Monitoring Activities, which refer to a set of Monitoring guidelines approved by the Meeting of MED POL Focal Point (October 2021) 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 required also defining Integration Rules for Assessments. Given the differences among the EOs, the rules were primarily 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.

17. The rules for an integrated monitoring scheme were set to provide integrated assessments in a cost-effective way of the EOs and CIs. Rules for 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 (UNEP/MAP – MED POL, 2021).

18. By taking account of this initial work, as well as the relevant best practices coming from the EU MSFD implementation and IMAP monitoring practices, the interrelations of IMAP CIs of EO5, EO9 and EO10, as well as their interrelations with EO1, EO7 and EO8 was provided.

19. 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 in Table I., Annex I (CH 2); 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 II, Annex I (CH 2); 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 III, Annex I (CH 2).

20. 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 integrated in present IMAP monitoring practices.

21. Considering the 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 I, II and III), the integration of monitoring areas/units for the respective CIs was defined in Table IV, Annex I (CH 2). Detailed elaboration related to the parameters measured and temporal scales for EO5 and EO9 can be found in UNEP/MAP -MED POL, 2021.

2.4. The rules for aggregation and integration of assessments

22. 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 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.

23. A distinction was 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 related to point sources were 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/onshore waters only, while data collected in the offshore monitoring units are indicative of the offshore status. Assessments made on the sub-division level, or higher level (i.e. sub-regional/regional levels), should take into consideration that the results on coastal/onshore 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.

24. 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 sub-division level is considered meaningful. The weighting method depends on the GES assessment method to be used and may be related to both coastal/onshore waters areas and number of stations. For CIs 19, 20, 23 (sea surface microplastics), and CI24, an integration up to either the sub-division or the sub-region level is considered meaningful and a weight factor is not needed. For CI21 which is relevant to local conditions in coastal/onshore waters, the integration of this information beyond the coastal/onshore waters part of the sub-divisions 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 sub-region level. A very high level of integration on the sub-region or even region level can be done, but it may mask the information on the lower levels and impact negatively the decision-making process.

25. The above findings are shaped in a tabular matrix of the nesting aggregation scheme for areas of assessment Table V, Annex I (CH 2). This proposal was applied within preparation of the 2023 MED QSR. It further refined the initial proposal for nesting scheme for IMAP EOs 5, 9 and 10[4]. It is also compatible to the MSFD implementation guidance. The colours in Table V 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.

2.5. The methodologies applied to support aggregation and integration of IMAP Pollution Cluster assessments

26. Further to new and/or updated assessment criteria for Common Indicators 13, 17 and 20, as well as the assessment methodologies set for IMAP Common Indicators 13 and 14; 17, 18, 20 and 21, the assessment findings generated per sub-divisions by using available datasets were integrated and aggregated into the assessment findings for four Mediterranean sub-regions. Given lack of data reporting as required by Decision IG. 23/6 on the 2017 MED QSR, it was impossible to ensure optimal application of the integration and aggregation rules, and therefore to ensure optimal integration of IMAP Common Indicators within specific Ecological Objectives (EO), and thereafter of Ecological Objectives at the level of IMAP Clusters, rather than by individual CI which was the approach of the 2017 MED QSR. However, compatible methodologies for GES assessment were used for EO5 and EO9, as well as for EO10 at certain extent. This will also facilitate optimal integration of the Ecological Objectives in the future QSRs.

27. Table 2.5.1 summarizes the methodologies used for the preparation of the 2023 MED QSR IMAP Pollution Cluster assessments per sub-divisions i.e. per sub-regions. The aggregation is built further to a setting of the four Mediterranean sub-regions for Initial environmental Assessment undertaken in 2012, as well as data grouping for calculation of the assessment criteria and the preparation of assessments within the 2017 MED QSR, and an update of the assessment criteria which was undertaken from 2020-2022.

28. In the region of Mediterranean Sea, four main sub-regions have been recognized for practical reasons and for the purpose of the UNEP/MAP 2011 Initial Integrated Assessment[5] and the Med QSR 2017 assessment, namely: the Western Mediterranean Sea, the Adriatic Sea, the Central Mediterranean , and the Aegean and Levantine Seas in the Eastern Mediterranean part. The sub-divisions (i.e., subareas/seas) for IMAP Pollution Cluster have been initially identified according to availability of database sources for the purpose of development of the assessment criteria for pollution and the assessments within the preparation of the 2017 MED QSR.

29. Sub-divisions were further analyzed to support optimal application of the assessment criteria in the four Mediterranean sub-regions by considering data aggregation for update of the assessment criteria, as well as relevant sources. The nesting scheme (Table V, Annex I (CH 2);) of the Mediterranean sub-regions and sub-divisions aggregation is as follows: (i) coastal/ onshore waters; (ii) national sub-divisions; (iii) regional sub-divisions; (iv) sub-regions; (v) Mediterranean Region.

Table 2.5.1. The spatial distribution of the methodologies used for assessment of the four Mediterranean Sub-regions

CIs 13&14		
Sub-region	**Sub-division**	**Methodology**
Aegean and Levantine Seas (AEL)	Aegean Sea (AEGS)	Ongoing
	Levantine Sea (LEVS)	G/M comparison
Adriatic Sea (ADR)	North Adriatic (NAS) *****	

[4] Proposed assessment scales for IMAP Common Indicators (after 2017 MED QSR and 2017 MEDCIS workshop)
[5] UNEP/MAP (2011). UNEP(DEPI)/MED WG.363/Inf.21. Initial Integrated Assessment

	Central Adriatic (CAS) *	NEAT assessment methodology
	South Adriatic (SAS) *	
Central Mediterranean Sea (CEN)	Central Mediterranean (CEN)	Ongoing
	Ionian Sea (IONS)	Ongoing
Western Mediterranean Sea (WMS)	Alboran Sea (ALBS)	G/M comparison
	Central Western Mediterranean Sea (CWMS)	Ongoing
	Tyrrhenian Sea (TYRS)	Ongoing
CI 17		
Sub-region	**Sub-division**	**Methodology**
Aegean and Levantine Seas (AEL)	Aegean Sea (AEGS)	CHASE+ assessment methodology
	Levantine Sea (LEVS)	
Adriatic Sea (ADR)	North Adriatic (NAS) *	NEAT assessment methodology
	Centrale Adriatic (CAS)*	
	South Adriatic (SAS) *	
Central Mediterranean Sea (CEN)	Central Mediterranean Sea (CEN)	CHASE+ assessment methodology
	Ionian Sea (IONS)	
Western Mediterranean Sea (WMS)	Alboran Sea (ALBS)	NEAT assessment methodology
	Central Western Mediterranean Sea (CWMS)	
	Tyrrhenian Sea (TYRS)	
CI 18		
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS		The assessment approach for biological effects based on the use of the literature sources only
CI 20		
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS		The assessment approach for contaminants in seafood based on the concentration limits for the contaminants regulated in EU Regulations
CI 21		
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS		The assessment approach for bathing water quality based on complementary use of the assessment results as presented in the Assessment report from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020 and the assessment of monitoring data reported for IMAP

cCI 26	
The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The adapted exposure index and assessment methodology as provided in the document “Setting of EU Threshold Values for impulsive underwater sound - Recommendations from the Technical Group on Underwater Noise (TG Noise), available at this URL The adaption of the assessment methodology was undertaken further to the proposal of the IMAP Guidance Factsheet for cCI 26.
cCI 27	

The four Mediterranean Sub-regions: AEL, ADR, CEN and WMS	The adapted exposure index and assessment methodology as provided in the document “Setting of EU Threshold Values for continuous underwater sound - Recommendations from the Technical Group on Underwater Noise (TG Noise), available at this URL The adaption of the assessment methodology was undertaken further to the proposal of the IMAP Guidance Factsheet for cCI 27.

* Referred to as NAS (Northern Adriatic Sea), CAS (Central Adriatic Sea) and SAS (Southern Adriatic Sea) in NEAT assessment, instead of NADR (North Adriatic), MADR (Middle Adriatic) and SADR (South Adriatic), respectively.

2.5.1. The NEAT IMAP GES Assessment methodology for IMAP Common Indicators 13, 14 and 17

30. 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 developed to assess biodiversity status of marine waters under the MSFD and has been used to assess different ecosystem components and geographical areas (Nemati et al., 2017; Borja et al., 2019; Pavlidou et al. 2019; Kazanidis et al., 2020; Borga et al., 2021). NEAT uses a combination of high-level integration of habitats and spatial assessment units (SAUs) and an averaging approach, allowing for specification on structural and spatial levels, applicable to any geographical scale. The use of NEAT is not limited to the assessment of biodiversity but can be used for assessment of pollution impact (UNEP/MAP – MED POL 2022, 2023). 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 - nonGES) (Uusitalo et al., 2016). Essentially, the final assessment value is calculated as a weighted average. The weighting factors are based on the respective surface of the areas and are combined with the respective monitoring data for the indicator/chemical contaminant in question. The total weight of a SAU is not the simple ratio of each SAU area to the total area of the parent SAU. The process of distributing the weight is more complex. SAU weighting by the NEAT tool has two options: i) do not weight by SAU area: weights are calculated based just on the nesting hierarchy of the SAUs; ii) weight by SAU area: weights are calculated based on the nesting hierarchy and the SAU surface area. For the present assessment the option ii) was followed. In all cases, the number of nesting levels and data availability per SAU is considered in the calculation of weights ((UNEP/MAP – MED POL 2022, 2023).

31. 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, the standard error/ standard deviation of every observed indicator value is used (Borja et al., 2016). Therefore, the standard deviation values as obtained from the monitoring data play a major role in the uncertainty associated with the final assessment result. This emphasizes the importance of the standard deviation for the accuracy and evaluation of the final assessment result. Detailed elaboration of adjusted application of NEAT software for GES assessment of IMAP CI 17 is provided in UNEP/ MAP – MED POL, 2023.

32. As it is indicated in several UNEP/MAP documents (UNEP/MAP (2016; 2019; 2021)), the NEAT 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. To this aim, the two types of scales (i.e. scales of monitoring and scales of assessment) are interrelated; however, a clear description of them is needed 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. In this regard, the integration and aggregation rules were applied in the NEAT IMAP GES assessment methodology for assessment of the IMAP Pollution Cluster Common Indicators.

33. The initial proposal related to scales of assessment for IMAP Pollution and Marine Litter Cluster, was agreed by the Meeting of Cor Mon on Pollution Monitoring (2-3 April 2019) and the 7th Meeting of EcAp Coordination Group (September 2019). This proposal was further elaborated by developing the assessment methodologies (listed in Table 2.5.1) which were approved for their application within the

preparation of the 2023 MED QSR by the Meetings of CorMon on Pollution Monitoring that was organized in 2021 (26-28 April) and 2022 (27 and 30 May).

34. The IMAP NEAT GES assessment methodology was tested, and thereafter applied, first to the assessment of contaminants (CI 17), and then to chl*a* (CI 13) and nutrients (CI 14) in the Adriatic Sea Sub-region.

35. For implementation of the updated nested aggregation scheme, the scales of assessment were defined at national part of sub-division level within application of the NEAT IMAP assessment methodology in the Adriatic Sea and the Western Mediterranean Sea Sub-regions. Relevant geographical information in the form of GIS-based layers were coupled, along with application of the rules of integration and aggregation. The priority at this stage of IMAP implementation was given to the work on geographical aggregation and assessment scaling rather than integration**.**

36. The first step in implementing the nested approach was the delimitation of the areas of assessment within the Adriatic Sea Sub-region and later on within the Western Mediterranean Sub-region based on the areas of monitoring defined by concerned Contracting Parties, along with the harmonization of the scales approach between the Contracting Parties (CPs) i.e., scaling up the marine assessment to sub-regional and regional scales within the integration process as required under IMAP.

37. The definition of the areas of assessment is undertaken as indicated in IMAP by applying relevant criteria, e.g. representativeness/importance of the areas of monitoring for establishing 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). The existing monitoring and assessment areas defined by the concerned CPs were used, in case they were compatible with IMAP requirements; in case inconsistency appeared, the necessary adjustments were undertaken.

38. For the purposes of the thematic assessments preparation data on contaminants (CI 17), chl*a* (CI 13) and nutrients (CI 14) which were produced within the implementation of the national monitoring programmes of the CPs and reported to the IMAP Info System or to the European Marine Observation and Data Network (EMODnet) have been collated and quality checked for their use for an upgrade of the assessment criteria. In parallel, the IMAP Spatial Assessment Units (SAUs) were defined in the 3 steps approach per each of the Adriatic countries separately; afterward, their nesting within three sub-divisions of the Adriatic Sea sub-region was undertaken i.e., in the North, Central and South Adriatic.

39. The assessment results per contaminant were spatially integrated within the nested scheme at i) the IMAP national SAUs & sub-SAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of Sub-Divisions (NAS-1, NAS-12, CAS-1, CAS-12, SAS-1, SAS-12); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (Adriatic Sea). At the same time, aggregation of all contaminants data was done in order to obtain one chemical status value (NEAT value) for all the levels of the nesting scheme i.e., the results were provided per contaminant per habitat per SAU in the finest level which are: i) integrated along the nesting scheme; and ii) aggregated for all contaminants and habitats per SAU leading to one NEAT value per SAU.

40. The IMAP NEAT GES assessment methodology was tested and then applied for assessment of eutrophication in the Adriatic Sea Sub-region further to results achieved by its application for assessment of CI 17. The same SAUs nested scheme was applied for IMAP NEAT GES assessment of CIs 13&14, whereby an additional geospatial layer was set to ensure an optimal integration and aggregation of the assessments across different ecosystem types (coastal and offshore), by considering the water types existing in IMAP SAUs.

41. Following the methodology applied in the Adriatic Sea Sub-region, the same approach was applied to the Western Mediterranean Sub-region. For the step of nesting, the areas of assessment were first classified under the 3 sub-divisions of the Western Mediterranean Sea (i.e. ALBS, CWMS, TYRS). The nesting of the areas was made in a 4 levels' scheme where 1st level is the finest and 4th level is the highest. Given lack of data reporting in offshore zone, the integration of the assessment results was possible in coastal assessment zone only under a 2 levels` hierarchical scheme and the integration of the assessment results was conducted for the coastal zone of the Alboran (ALBS) and Tyrrhenian Seas (TYRS) sub-divisions. For the central part of the Western Mediterranean Sea (CWMS), further lack of data for ~47% of the coastal IMAP SAUs surface area hindered the application of a hierarchical nested scheme of SAUs for this area. A simplified application of the NEAT tool was chosen only for the IMAP SAUs for which data exist without any spatial integration on the CWMS level, and in order to obtain an assessment on the finest level of subSAUS, comparable to the subSAUs of the ALBS and TYRS.

2.5.2. The Environmental Assessment methodologies in the sub-regions/sub-divisions with insufficient data reported for IMAP Common Indicators 13, 14 and 17

42. For the sub-regions/sub-divisions with insufficient data reported for application of the NEAT IMAP GES assessment methodology along the nested areas of assessment, the four other methodologies were elaborated: i) the CHASE+ (Chemical Status Assessment Tool) methodology for assessment of CI 17 and ii) the Ecological Quality Ratio (EQR); iii) the simplified EQR methodology and iv) the simplified G/M comparison methodology, the later three methodologies for assessment of IMAP CIs 13 and 14.

2.5.2.1. The distribution of the assessment methodologies used for assessment of IMAP CIs 13, 14 and 17 in the four Mediterranean sub-regions and related sub-divisions is shown above in Table 2.5.1. The CHASE+ methodology

43. The CHASE+ (Chemical Status Assessment Tool) methodology was tested and then applied for assessment of IMAP CI 17 further to its application by the European Environmental Agency (EEA) to assess environmental status categories for the European Seas (Andersen et al. 2016, EEA 2019)[6]. This assessment methodology uses just one threshold, compared to the two used in the traffic light system.

44. The first step in this tool is to calculate the ratio $C_{measured}/C_{threshold}$ (C is the concentration) called the contamination ratio (CR) for each assessment element in a matrix. Then a contamination score (CS) is calculated as follows[7]:

$$CS = \frac{1}{\sqrt{n}} \sum_{i=1}^{n} CR_i$$

where n is the number of elements assessed for each matrix.

45. Based on the contamination ratio (CR) or on contamination score (CS), the elements are assessed. In line with the results of assessments, the stations/areas can be classified into non problem area (NPA) and problem area (PA), by applying 5 categories: NPAhigh (CR or CS=0.0-0.5), NPAgood (CR or CS =0.5-1.0), PAmoderate (CR or CS =1.0-5.0), PApoor (CR or CS =5.0-10.0) and PAbad (CR or CS > 10.0). NPA areas are considered in GES while PA areas are considered as non-GES. The boundary limit of 1 between GES and non-GES is based on the choice that only values that are equal or below the threshold are considered in GES.

[6] Andersen, J.H., Murray, C., Larsen, M.M., Green, N., Høgåsen, T., Dahlgren, E., Garnaga-Budrė, G., Gustavson, K., Haarich, M., Kallenbach, E.M.F., Mannio, J., Strand, J. and Korpinen, S. (2016) Development and testing of a prototype tool for integrated assessment of chemical status in marine environments. Environmental Monitoring and Assessment 188(2), 115.
EEA (2019) Contaminants in Europe's Seas. Moving towards a clean, non-toxic marine environment. EEA Report No 25/2018.
[7] The contamination sum minimizes the problem of 'dilution' of high values when several substances from an area are analyzed, and takes to some extent possible synergistic effects of contaminants into account by using square root of 'n' instead of 'n'.

46. Both methodologies i.e. the NEAT and CHASE+ need to define decision rules to determine the quality status. One decision rule used is the “One out all out approach” (OOAO) that says that if one element of the assessment is not in good status, the whole area is described as not in GES. This decision rule is very stringent. An additional approach is based on setting a limit, such as a proportion (%) of elements, that should each be in GES for the area to be classified as in GES. Within the present work it was recommended that if at least 75% of the elements are in GES, the station should be considered in GES. The same recommendation was given when assessing certain areas or the whole Sub-region or Sub-division i.e., when 75% of the stations are in GES for a certain parameter, the whole Sub-region is in GES for this particular parameter and not the overall status of the Sub-region or Sub-division. This more lenient approach for the GES-non GES decision rule compensates for stricter thresholds applied within the CHASE+ methodology (UNEP/MAP – MED POL, 2023). This approach was discussed and approved by the Meeting of CorMon Pollution Monitoring, 2022, and therefore it is also applied in the 2023 MED QSR assessments.

2.5.2.2. The Ecological Quality Ratio (EQR) methodology

47. Along with the application of the IMAP NEAT GES assessment methodology in the Adriatic Sea Sub-region, as explained above, the application of the Ecological quality ratio (EQR); the Simplified EQR methodology, and the Simplified methodology based on G/M comparison was also explored in another three Mediterranean Sub-regions with insufficient data for the IMAP NEAT GES assessment.

48. The ecological quality ratio (EQR) is a dimensionless measure of the observed value of an indicator compared with reference conditions. The ratio goes from 0 (large deviation) to 1 (when the observed value is equal or better than the reference conditions).

49. The application of the EQR method was found relevant for assessment of IMAP Common Indicators 13 & 14 where full set assessment criteria for Chl*a*, DIN and TP exist. Typology related assessment needs to be performed.

50. Given the lack of data reported by the CPs, this methodology was impossible to apply within the preparation of the 2023 MED QSR. However, key aspects of this methodology, as presented here-below, are developed for future application within the implementation of IMAP.

51. The EQR, which is set as the relative deviation from the reference conditions (RC), must be calculated for every boundary value using the simple equation:

$$EQR_{actual} = RC/Chl\mathit{a}_{annual\ G\text{-}mean} \quad (1)$$

where for $Chl\mathit{a}_{annual\ G\_mean}$, the Chl*a* concentrations defined for every boundary value must be used.

52. As Chl*a* concentrations are derived using non-linear relationships, the corresponding EQRs are not on a linear equidistant scale. To calculate the EQRs values normalized (Anon, 2005) to the scale from 0 to 1 (EQR_{norm}) and set them equidistantly, with respect to the calculated values designated as EQR*actual*, the following conversion functions need to be used:

Chl*a* - $EQR_{norm} = 0.2586 \ln(EQR_{actual}) + 0.9471$ for Type I coastal waters (2)

TP - $EQR_{norm} = 0.3183 \ln(EQR_{actual}) + 0.9521$ for Type I coastal waters (3)

Chl*a* - $EQR_{norm} = 0.1824 \ln(EQR_{actual}) + 1.0253$ for Type I open waters (4)

DIN - $EQR_{norm} = 0.1216 \ln(EQR_{actual}) + 1.0209$ for Type I open waters (5)

Chl*a* - $EQR_{norm} = 0.1488 \ln(EQR_{actual}) + 1.0385$ for Type I Montenegro (6)

DIN - $EQR_{norm} = 0.0966 \ln(EQR_{actual}) + 1.0378$ for Type I Montenegro (7)

Chl*a* - EQRnorm = 0.246 ln(EQRactual) + 0.981 for Type II A Adriatic coastal waters (8)

TP - EQRnorm = 0.333 ln(EQRactual) + 0.979 for Type II A Adriatic coastal waters (9)

53. The actual and normalized EQRs for all boundary values of Types I, and II A Adriatic are shown in Tables I and II, Annex II (CH 2), respectively.

54. Finally, for each considered variable, sampling station or area is classified in GES or non-GES, comparing the EQR value of the indicator to the class boundary value.

2.5.2.3. The Simplified EQR methodology

55. The application of the simplified EQR methodology was found relevant where complementary data availability i.e. *in situ* and from remote sensing is found for Chla only and the typology related assessment is not possible to apply. Given the lack of homogenous quality assured data reported by the CPs even for Chla only, an application of the simplified EQR method was impossible for any sub-region/sub-division within the preparation of the 2023 MED QSR.

56. For the application of the simplified EQR method within the IMAP implementation, thresholds need to be used to define the boundary limits between an acceptable and unacceptable environmental status (i.e., Good Environmental Status (GES) or non-Good Environmental Status (non-GES)). In the absence of the assessment criteria for nutrients, application of the simplified EQR method is foreseen by relying on the experiences gained in the Baltic Sea (Andersen et al. 2011; HELCOM 2010). For an indicator showing a positive response (i.e., nutrients and Chl*a*), it indicates that the threshold has an upper limit of +50 % deviation from reference conditions. Setting the threshold to 50 % implies that low levels of disturbance (defined as less than +50 % deviation), resulting from human activity, are considered acceptable, while moderate (i.e., greater than +50 %) deviations are not considered acceptable for the water body in question.

2.5.2.4. The Simplified methodology based on G/M comparison

57. Given the lack of quality-assured homogenous data prevented the application of NEAT, EQR and simplified EQR assessment methodologies, the assessments within the 2023 MED QSR were prepared only by evaluating data available for Chla from remote sensing sources, whereby the typology-related assessment is impossible to apply. The application of this methodology relied on the use of COPERNICUS data for Chl*a*.

58. The data were aggregated as a 5-year geometric mean and normalized in order to ensure their comparability between the areas of assessment. For normalization, the bestNormalize package in R was used. The best normalization transformation was identified as the Ordered Quantile normalizing transformation (Bartlett, 1947, Beasley et al., 2009). From the normalized values, the following values are back-transformed: the 10th percentile as the reference condition, the 50th percentile as the mean value of the distribution, and the 85th percentile ~ mean +1 SD that represents the G/M threshold.

59. Finally, each considered observation point or area was classified in GES or non-GES status, comparing the value of the indicator to the boundary limit between G/M i.e. back transformed the 85th percentile of the normalized distribution.

2.5.3. The comparison and harmonization of the assessment methodologies

The assessment methodologies applied for assessment of IMAP CI 17

60. In order to avoid possible bias in the Mediterranean regional assessment that may occur as a result of the use of different assessment methodologies in different areas, comparisons were performed i.e., between i) the "traffic light" and the CHASE+ in the LEVS Sub-division; ii) the NEAT and the CHASE+

in the ADR Sub-region and iii) the NEAT and the CHASE+ in the WMS Sub-region. The comparisons were performed to decrease uncertainty and to harmonize among assessments performed in different sub-regions and sub-divisions, with different number of sampling locations and measurements.

61. The three assessment methodologies use thresholds[8] and decision rules to classify areas or the whole Sub-region or sub-division as GES or non-GES for a certain parameter, i.e. the whole sub-region is in GES for this particular parameter. The "traffic light" uses two thresholds (MED_BAC and MED_EAC) to classify three environmental categories (2 GES (good, moderate), 1 non-GES (bad)).

62. It was shown in the assessment of the Levantine Sea basin that the traffic light system is more lenient than CHASE+ and may mask the classification as non-GES of possible problematic areas for certain contaminants. Therefore, the "traffic light" was not further utilized.

63. The initial comparison of the NEAT and CHASE+ assessment methods by using available data as reported by the CPs, showed that the two assessment methodologies are compatible only at the level of very basic assessment per contaminant, per SAU. Still at this level some discrepancies appeared for the non-GES categories moderate and poor. When aggregation of all contaminants data was attempted to obtain the overall pollution (CI17) assessment (NEAT overall value and contamination score (CS) by applying CHASE+ assessment methodology), the two methods behaved differently. These discrepancies were related to different calculations within the two assessment methods for the aggregation of contaminants, as well as differences in setting the boundary limits between the moderate/poor, and poor/bad classes

64. A first step to achieve harmonized assessments is the use of compatible GES/nGES threshold values for all sub-regions, sub-divisions.

65. The MedEAC threshold was originally used for the assessment of the Adriatic Sea Sub-region, following the IG.22/7 and IG.23/6. However, within initial assessment of the LEVS Sub-division (UNEP/MAP - MED POL, 2022), it was found that this threshold does not fit the purpose of a meaningful assessment, and it was suggested to use GES/nGES thresholds based on the BAC values of the area (xBAC). BAC values were chosen as thresholds given that the high values of the EACs in combination with the lack of the spatial assessment units nesting would result in non-reliable assessment findings.

66. Based on the initial assessment results for the Levantine Sub-division, and the subsequent comparison of the NEAT and the CHASE+ in the ADR Sub-region, for TM, the threshold was set as 1.5 BACs while for organic contaminants, with less available data than TM, the threshold was set as 2 BACs. These coefficients were also selected further to the experience of the EEA (2019) regarding application of the CHASE+ methodology in the European Seas.

67. In this way a finer classification of areas with concentrations >BAC is achieved, in line with the precautionary principle. Recognizing sub-regional differences in the background concentrations, the (xBAC) approach, is based on the relative distance of contaminants concentrations from the sub regional BAC values, in contrast to the MedEAC thresholds which is based on toxicological effects on biota species in specific area from other areas. This decision aligns the present work with the GES target set for CI 17 indicating that GES cconcentrations of specific contaminants need to be held below Environmental Assessment Criteria (EACs) or below reference concentrations.

68. Further comparison of the NEAT and CHASE+ assessment methodologies undertaken in the WMS (UNEP/MAP – MED POL, 2022)by applying this approach showed that using the (xBAC) as GES/nGES thresholds clearly provides finer assessment classifications.

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[8] The updated regional and Sub-regional BAC values, as well as the adopted Med EACs, as presented in UNEP/MAP-MED POL, 2022, were used as thresholds in the assessments.

69. In addition, it should be noted that application of the BACs within the CHASE+ application for the preparation of the 2023 MED QSR is related to the experience of the European Seas by the EEA (2019) regarding application of the CHASE+ methodology whereby the use of threshold values depended on the contaminant and which included Environmental Quality Standards (EQS), Environmental Assessment Criteria (EAC), Background Assessment Criteria (BAC) and Ecological Quality Objectives (EcoQOs).

70. Further to setting of the compatible GES/nGES threshold values for all sub-regions/sub-divisions, the approach described here-below is followed to overcome the above-described discrepancies and to ensure compatible assessments for all subregions/sub-divisions of the Mediterranean Sea on the SAU and on station levels for the purposes of the preparation of 2023 MED QSR. The approach is based on the application of a tailor-made assessment based on the general rationale of the CHASE+ tool while ensuring compatibility with the NEAT tool:

i) For sub-regions where the CHASE+ assessment methodology is applicable: Calculation of contamination ratios (CRs) based on the (xBAC) thresholds;
ii) For sub-regions where the CHASE+ assessment methodology is applicable: Calculate the CS for the overall CI17 aggregated assessment per station as a simple average of CRs and not as used by the EEA, where CS is calculated as the sum of CR divided by the square root of the number of CRs in the sum;

iii) For all Sub-regions and for both NEAT and CHASE+ assessment methodologies: The GES/non-GES boundaries are based on the BAC values. The BAC values (xBAC) multiplied by 1.5 for Cd, Hg, Pb and by 2 for PAHs and PCBs were approved by the Meeting of CorMon Pollution (27 and 30 May 2022). This approach was chosen because it is based on the Mediterranean sub-regional background concentrations of contaminants, therefore having the boundary limits based on the values calculated from monitoring data reported by the CPs, and because it is more stringent than the Med_EAC approach. At the same time, it corresponds to the definition of the GES CI 17 target according to which the concentrations of specific contaminants need to be kept below Environmental Assessment Criteria (EACs) or below reference concentrations (UNEP/MAP – MED POL, 2019). In many cases the Med_EAC thresholds are higher than the maximum value recorded for a particular contaminant, resulting in a very lenient classification of the SAUs/stations. In this way biased assessments in different Mediterranean sub-regions are avoided.
iv) For all Sub-regions: Align the moderate/poor and the poor/bad boundary limits/thresholds between the two assessment methodologies. For the moderate/poor the use of 2(xBAC) value is proposed and for the poor/bad the 5(xBAC) value. In this way, a fine classification in line with the precautionary principle is provided. The NEAT tool is flexible and accepts either calculated thresholds values by the tool itself (based on the GES/nGES and the maximum concentration of contaminants), or threshold values predefined by the user. In the present assessment all thresholds are user defined. In the CHASE+ tool the CR or CS ratios for the moderate/poor and poor/bad are set at 2x and 5x times the GES/nGES threshold, instead of 5x and 10x that are suggested by the tool. The updating of the thresholds is shown below in Table 2.5.2 a.

71. A comparison between the NEAT and CHASE+ results for the WMS sub-region was performed by applying above approach further to the recommendations for the harmonization of the two assessment methods (UNEP/MAP – MED POL, 2023) . Briefly all thresholds used were identical in the two methodologies, while the CHASE+ methodology was adapted regarding the calculation of the CS score for compatibility reasons. Consolidated results on the percentage of SAUs as classified by the two assessment methodologies are provided (UNEP/MAP – MED POL, 2023). , using the xBAC GES/nGES

boundary limit/threshold. Based on these comparisons it is apparent that the harmonization of the two tools in this case gives identical results for the classification (in-GES or non-GES) of the individual contaminants assessments per SAU. There are very small differences between the statuses found for the individual contaminants per SAU, i.e., small differences in the division between high and good statuses the in-GES classification and between moderate and poor in the non-GES classification. When aggregation is conducted for all contaminants on the individual SAU level comparisons differ by 5% and still can be considered acceptable

72. The harmonization of the NEAT and CHASE+ assessment methodologies was as good as possible. They are still different methodologies and the results will not be identical, however the harmonization ensured their alignment to the extent which prevents bias assessment of the four Mediterranean sub-regions within the preparation of the 2023 MED QSR. The NEAT is the methodology which properly supports efforts aimed at the GES assessment in line with the Decision IG. 23/6 on the 2017 MED QSR (COP 20, Tirana, Albania, 17-20 December 2017), and therefore its further application across all four Mediterranean sub-regions should be foreseen within preparation of the future QSR. The CHASE+ assessment methodology may continue being used in specific cases, i.e., for the local areas and limited assessments with insufficient data reported for the GES assessment to guide decision making.

Table 2.5.2.a Assessment classification boundary limits/thresholds for a harmonized application of IMAP NEAT and CHASE+ assessment methodologies in the Mediterannean Sea sub-regions.

	GES		**non-GEs**		
IMAP – traffic light approach	Good	Moderate	Bad		
NEAT tool	High	Good	Moderate	Poor	Bad
	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤GES/nGES threshold	GES/nGES<meas. conc. ≤ moderate/poor threshold	moderate/poor threshold <meas. conc. ≤ max. conc.	**Max. conc.**
Boundary limits and NEAT scores **0**	1 < score ≤0.8	0.8<score≤ 0.6	0.6<score ≤ 0.4	0.4< score ≤0.2	Score<0.2
Thresholds	**BAC**	**(xBAC)**	**2 (xBAC)**	**5 (xBAC)**	
CHASE+ tool	High	Good	Moderate	Poor	Bad
Thresholds	**1/2(xBAC)**	**(xBAC)**	**2(xBAC)**	**5(xBAC)**	
CHASE+ Scores	0 <CR,CS ≤0.5	0.5<CR,CS≤ 1	1<CR,CS ≤ 2	2< CR,CS ≤5	CR,CS> 5

Assessment methodologies applied for assessment of IMAP CI 14

73. By selecting the 85th percentile of the normalized distribution as G/M boundary limit, therefore as the limit between the acceptable and the unacceptable statuses i.e. GES and non GES in the Alboran Sea, the compatibility of the classification within application of the Simplified assessment methodology based on G/M comparison in the Alboran Sea and the Levantine Sea was achieved with a five classes GES/non GES scale set for IMAP NEAT GES assessment of the Adriatic Sea Sub-region. The harmonization was achieved to the maximum possible extent given the Simplified assessment methodology based on G/M comparison and NEAT GES assessment methodology are different methodologies which application

across the Mediterranean Sub-regions/Sub-divisions was conditioned with the statuses of data reported by the CPs.

74. Therefore, the bias assessment of CI 14 within the 2023 MED QSR was avoided as the Simplified G/M method relay on the assessment criteria corresponding to RC and G/M as stated in the Decision 22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP/MAP, 2016). Based on statistical calculations and related selection of the 85^{th} percentile ~ mean +1 SD represents the G/M threshold, the synchronization was achieved to the maximal possible extent between the classification statuses assigned in the Alboran Sea Sub-division, and those in the Adriatic Sea Sub-region (Table 2.5.2.b).

Table 2.5.2.b: Assessment classification for harmonized IMAP/NEAT and IMAP/Simplified G/M assessment methodologies application in the Mediterannean Sea sub-regions.

	GES			**non-GES**		
IMAP/NEAT	RC	High	Good	Moderate	Poor	Bad
Boundary limits and normalized NEAT scores	< RC/H limit, not in score scale	1 < score ≤ 0.8	0.8<score≤ 0.6	0.6<score ≤ 0.4	0.4< score ≤0.2	Score<0.2
IMAP/Simplified G/M						
Boundary limits*	$\leq 10^{th}$ %	$>10^{th}$% CHL_GM $\leq 85^{th}$%		CHL_GM $>85^{th}$ %		
G/nG threshold			**G/M**			
*** Percentile are calculated from normalized (with Ordered Quantile transformation) annual geometric mean (for at list 5 year)**						

2.5.4. The Environmental Assessment methodology applied for assessment of IMAP Common Indicator 18

75. The Meeting of Cor Mon on Pollution Monitoring (27 and 30 May 2022) recommended to continue applying the assessment criteria for biomarkers as set by Decisions IG. 22/7 (COP 19) and IG. 23/6 (COP 20) given a present lack of data reporting for IMAP Common Indicator 18.

76. For the same reason, within the preparation of the 2023 MED QSR, the assessment approach applied was based on the use of literature sources due to the absence of any national data related to CI 18.

77. Given a complete lack of data reporting, the GES assessment of CI 18 was impossible within the preparation of the 2023 MED QSR. Instead, assessment was performed based on bibliographic studies, using newer available scientific literature i.e., the studies on biomarkers in the Mediterranean Sea since 2016, compared to the literature used for the preparation of the 2017 MED QSR.

78. The studies surveyed were chosen based on the following criteria:

i) Containing data only from the Mediterranean Sea;
ii) Containing data from studies conducted since 2016[9] and published since 2018. It should also be mentioned that there are papers that were published in 2020-2022, however they present data collected prior to 2016. Those were not considered.
iii) Containing data from monitoring or field experiments (including transplantation) only, but not from laboratory studies. Short term laboratory exposure experiments were not reviewed because they do not present the status of the environment, only the sensitivity of biota to contaminants and the dose/response relationship.

[9] Except for one study conducted in Turkiye due to the lack of data in the area and the very relevant biomarkers measured.

2.5.5. The Environmental Assessment methodology applied for assessment of IMAP Common Indicator 19[10]

2.5.6. The Environmental Assessment methodology applied for assessment of IMAP Common Indicator 20

79. The previous assessment of CI 20, performed during the preparation of the 2017 Mediterranean Quality Status Report (2017 MED QSR), was based on bibliographic studies and scientific documents in the Mediterranean Sea. There were no data sets reported to MED POL for IMAP CI 20.

80. In the 2017 MED QSR it was concluded that " a few research studies and EU policy driven reports i.e., related to MSFD in some Mediterranean countries investigated the occurrence of contaminants in seafood from an environmental perspective i.e., the ecosystem approach, which are exceeding the maximum regulatory levels established within regulatory standards. Overall, from available studies, no major significant concerns or extreme high levels were observed within these recent research studies by different authors and no confirmation based on temporal trends have been performed yet".

81. Updated Guidance Fact sheet for IMAP CI 20 (UNEP/MAP – MED POL, 2019) adopted in 2019, stated that the initial target of GES " will be to maintain the chemical contaminants of human health concern under regulatory levels in seafood set/recommended/agreed by national and/or international authorities and their trends with regard their occurrence should decrease pointing towards zero events". CI 20 status should be assessed based on the following sub-indicators: number of detected regulated contaminants in commercial species and the number of detected regulated contaminants exceeding regulatory limits. Both are determined via monitoring by national regulatory and inspection bodies through statistics and databases. The indicator units were defined as frequencies (%) of the number of detected contaminants in individual commercial species and frequencies (%) of the number of detected contaminants exceeding regulatory limits.

82. Updated Data Standards and Data Dictionaries (DSs & DDs) aimed at collecting data on actual levels of contaminants that were detected and number of contaminants which exceeded maximum regulatory levels in commonly consumed seafood in the Mediterranean Sea were approved by the Meeting of CorMon Pollution (27 and 30 May 2022) (UNEP/MAP – MED POL, 2022). The list of contaminants included in CI 20 DSs & DD is as follows: Cd, Hg, Pb, four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene), dioxins, dioxin-like (dl) and non-dioxin-like PCBs (PCB 28, PCB 52, PCB 101, PCB 138, PCB 153 and PCB 180) and radionuclides. Non-regulated contaminants could be included in the IMAP CI 20 monitoring programme, but for the time being no concentration limits are set in the EU legislation. The concentration limits for the regulated[11] contaminants in the EU used for the preparation of Data Standards and Data Dictionaries for IMAP CI 20 (UNEP/MAP – MED POL, 2022). and UNEP/MAP 2023

83. As no data were reported for CI 20, the GES assessment for CI 20 was impossible within the preparation of the 2023 MED QSR. Therefore, environmental assessment of CI 20 was performed by using the following two approaches:

i) Assessment of the status based on data reported to IMAP-IS for CI 17 contaminants in biota up to 31st, October 2022, the cutoff date for data reporting for the 2023 MED QSR, using the EU concentration limits for regulated contaminants(UNEP/MAP MED – POL, 2022; 2023) ;
ii) Assessment of present status based on bibliographic studies, following the same approach applied for preparation of the 2017 MED QSR, however by using newer available scientific literature.

[10] This section is under preparation
[11] EU Directives 1881/2006, 835/2011, 1259/2011, 488/2014, 1005/2015

84. Both approaches consider the definition of GES for IMAP CI 20, as given in the Updated Guidance Fact sheet, according to which it is necessary to keep the concentrations of contaminants within the regulatory limits for consumption by humans i.e. initial GES target is to maintain the chemical contaminants of human health concern under regulatory levels in seafood that are set/recommended/agreed by national and/or international authorities; their trends with regard to their occurrence should decrease pointing towards zero events.

85. Within the present efforts to set the baseline to measure the trends of the concentrations of contaminants in seafood, account is taken of the JRC (2010)[12] which suggests to take into account "the frequency that levels exceed the regulatory levels, the actual levels that have been detected, the number of contaminants for which exceeding levels have been detected and in parallel the origin of the contamination (geological versus anthropogenic, local versus long distance)". It also stipulates that "Further an intake assessment taking into account the importance in the human diet of the species showing the exceeding levels could be taken into account. If regulatory levels are exceeded in one specie, that doesn't mean that all seafood consumption from this sub-region is dangerous".

86. The present data availability in IMAP IS and relevant scientific studies do not allow proposing boundary limit between GES and non-GES status for IMAP CI 20. The boundary limit should be primarily based on the frequency of contaminants` appearance. However, more substantive considerations need to be undertaken further to expected future sufficient data reporting by the CPs in order to propose GES-non-GES boundary limit based on the frequency of contaminants` appearance. All relevant national and international practices need to be taken into account, along with gathering information on cumulative impact of the contaminants on different seafood species and undertaking computation of daily/monthly intake and related risk analysis.

87. Therefore, the present initial marine environment assessment for IMAP CI 20 is based on calculation of number of data points exceeding the criteria i.e. the concentration limits for the regulated contaminants in the EU by considering data points extracted from IMAP IS CI 17 database, that are found relevant for assessment of CI 20, and from data based on the literature.

88. Monitoring of future trends of the contaminants` concentrations in seafood should be established in relation to such determined initial status, along with making efforts to set a GES-non-GES boundary limit.

2.5.7. The Environmental Assessment methodology applied for assessment of IMAP Common Indicator 21

89. Due to the lack of data reported for CI 21, the methodology used for assessment of bathing water quality within the 2017 MED QSR, was further elaborated for the preparation of the 2023 MED QSR. The assessment methodology defined in the IMAP Guidance fact sheet for IMAP CI 21 was adjusted to data availability for present assessment. It also included setting the boundary limit between GES and non-GES status regarding the pathogens in bathing waters.

90. Updated Guidance Fact sheet for IMAP CI 21 (UNEP/MAP – MED POL, 2019)was provided in 2019 further to the revised Mediterranean guidelines for bathing waters that was provided in 2007 based on the WHO guidelines for "Safe Recreational Water Environments" and on the EC Directive for "Bathing Waters" (Directive 2006/7/EC). The latter was made in an effort to provide updated criteria and standards that can be used in the Mediterranean countries and to harmonize their legislation in order to provide homogenous data.

91. The initial target of GES under Common Indicator 21, as stated in the updated IMAP Guidance fact sheet for CI 21 "will be an increasing trend in measurements to test that levels of intestinal

[12] https://mcc.jrc.ec.europa.eu/documents/201406241428.pdf

enterococci comply with established national or international standards and the methodological approach itself. Particularly, under Decision IG.20/9 and the EU 2006/7 Directive, excellent (95^{th} percentile < 100 CFU/100 mL) or good (95^{th} percentile < 200 CFU/100 mL) quality categories are set for the "last assessment" which means the last four years".

92. The COP 17 (UNEP/MAP, 2012)agreed on the threshold values in the Mediterranean region as presented in Table 2.5.3. In the present assessment these values are used to set the boundary limit between GES and non-GES status regarding the pathogens in bathing waters. Therefore, the categories A, B and C are considered as in GES while category D is considered as non-GES for intestinal enterococci (IE) in bathing waters in the Mediterranean (Annex III (CH 2)).

93. For the indicator calculation, the IMAP Guidance fact sheet for CI 21(UNEP/MAP – MED POL, 2019) provides the methodology (UNEP/MAP -MED POL, 2023) that is also aligned with Directive 2006/7/EC.

94. The methodology used in the EEA 2020 assessment of the state of bathing water quality was as defined in the EU 2006/7 Directive and in IMAP decision IG.20/9, i.e. the classification of the bathing waters was provided according to the 90^{th} or 95^{th} percentile of the log10 normal probability density function of microbiological data. The number of data points for each location was at least 16, over 4 bathing seasons[13], at least 4 for each bathing season. The assessment criteria applied for assessment of IMAP CI 21 are shown in Annex. III (CH 2).

95. It should be mentioned that the EU 2006/7 Directive defines two indicators: Intestinal enterococci (IE) (cfu/100 ml) and Escherichia coli (E. coli) (cfu/100 ml). Therefore, the classification of the bathing waters is based on the combination of both microbiological parameters, classifying the stations based on the worse status between the two criteria[14]. For example, if status for IE is excellent but for E. coli the status is poor, the station is classified as poor.

96. The same methodology used in the EEA 2020 of the state of bathing water quality was applied to the data set reported by Montenegro, Morocco and Lebanon using just intestinal enterococci as indicator.

97. This methodology could not be applied to data from Bosnia and Herzegovina and Israel because 16 data points for 4 consecutive bathing seasons were not available (Table 4.2.5.1). Therefore, for these 2 CPs, the classification was based on the geometric mean calculated for each location. The geometric mean was chosen because it reduces the effect of outliers on the mean and is not influenced by skewed distribution as the arithmetic mean. Table 2.5.3 compares between the two methodologies.

[13] Exceptions are outlined in Directive 2006/7/EC and in Decision IG.20/9. Shortly, bathing water quality assessments may be carried out on the basis of three bathing seasons if the bathing water is newly identified or any changes have occurred that are likely to affect the classification of the bathing water. Sets of bathing water data used to carry out bathing water quality assessments shall always comprise at least 16 samples. Only 12 samples may be used to assess bathing water quality in special circumstances when the bathing season does not exceed 8 weeks or location is situated in a region subject to special geographical constraints (Annex IV, paragraph 2).

[14] EEA Guidelines for the assessment under the Bathing Water Directive Prepared by: ETC/ICM (Lidija Globevnik, Luka Snoj, Gašper Šubelj), October 2021

Table 2.5.3: Comparison between the methodology used by the EEA and the methodology used in present document for the assessment of Bathing waters quality (CI 21)

Assessment methodology	EEA	Present assessment of IMAP CI 21*
Assessment Category	Based on Intestinal enterococci and Escherichia coli (cfu/100 mL)	Based on Intestinal enterococci (cfu/100 mL)
Number of data points	At least 16	Less than 16, depending on the CP*
Number of monitoring years	4	Less than 4, depending on the CP*
Classification of station	percentile evaluation of the log10 normal probability density function	Geometric mean

* Bosnia and Herzegovina and Israel. Lebanon, Montenegro and Morocco were classified using the same methodology as the EEA, using 16 data points over 4 consecutive bathing seasons, however using just Intestinal enterococci values and by applying percentile evaluation of the log10 normal probability density function.

2.5.8. *The Environmental Assessment methodology applied for assessment of IMAP Candidate Common Indicator 26 (cCI 26)*

98. The assessment for Candidate Indicator 26 (cCI 26) (low- and mid-frequency impulsive sounds) is performed in collaboration of the ACCOBAMS and the UNEP/MAP - MED POL based on data reported by the Contracting Parties to the ACCOBAMS through the International Noise Register for the Mediterranean Sea region managed by ACCOBAMS (INR-MED, currently available at this URL), as well as by using data generated through dedicated activities coordinated by the ACCOBAMS Secretariat which are aimed at enhancing the gathering of impulsive noise event data.

99. For the initial assessment of the noise within the preparation of the 2023 MED QSR, the methodology applied for assessment of the cCI 26 served as an indication of the anthropogenic pressures. Further, by including information about the habitat of noise-sensitive species, it was possible to move towards the assessment of whether the risk of the negative impacts occurring on populations of such species is acceptable. Specifically, the methodology for cCI26 (but also for cCI27) which was based on the Exposure Index i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE), on average over a year, ensured addressing the risk of extinction of noise-sensitive species due to exposure to underwater noise. This concept is at the basis of the noise assessment methodology developed by the TG-Noise under the scope of the MSFD-D11 with the active contribution of the ACCOBAMS and the UNEP/MAP - SPA/RAC.

100. The collaboration of the ACCOBAMS and the UNEP/MAP - SPA/RAC allowed to consider specificities of the Mediterranean Sea and ensure applicability of the assessment methodology developed under the scope of MSFD-D11 also for an initial assessment of IMAP cCI26. The assessment methodology conceived in this way is compatible with the initial proposal of the IMAP Guidance Fact sheets for cCIs 26 and 27 (UNEP/MAP – MED POL, 2019) which were presented for consideration of the Meeting of MED POL Focal Point (Istanbul, Turkey, 29-31 May 2019), prepared in line with the Monitoring strategy of ACCOBAMS developed in 2015 (ACCOBAMS, 2015; Maglio et al., 2014).

101. The proposed IMAP Guidance fact sheet for cCI 26 indicated the following target for achieving GES under cCI 26 "the number of days with impulsive sounds sources, their distribution within the year and spatially within the assessment area, are below thresholds". It should also be noted that considering 2022 EU TG-Noise technical guidance on threshold setting for impulsive noise, the following reformulation of this target for IMAP cCI26 is needed: "the extent (%) of habitat of noise-sensitive

species within the assessment area that is impacted by impulsive noise events is below thresholds". Given that proposed IMAP Guidance Factsheet for cCI 26 was not adopted by the Meeting of MED POL FPs, the definition of the GES target proposed by EU TG-Noise was applied for the present initial assessment of cCI 26 within the preparation of the 2023 MED QSR .

102. Particularly, under the EU TG-Noise methodology, Tolerable Status is defined when 10% or less of the habitat of noise-sensitive species is impacted by impulsive noise events on a daily average over a year. This threshold (10%) is valid for all MSFD regions and subregions. Therefore, it was also followed within the present initial IMAP cCI 26 assessment. The scales of assessment recommended by the Proposal of the IMAP Guidance Factsheet for cCI26 (2019 update) were the regional and sub-regional levels. This also corresponds to the recommendations made at EU level. Hence, the initial assessment findings for cCI 26 within the 2023 MED QSR were provided for the four IMAP Sub-regions of the Mediterranean Sea i.e. the Aegean and Levantine Sea, the Adriatic Sea, the Central Mediterranean Sea and the Western Mediterranean Sea Sub-regions.

103. The statistical calculations related to proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels were undertaken as far as possible in line with the Proposal of the IMAP Guidance fact sheet for cCI 26 to the quality of available data, while for performing the assessment it was necessary to calculate the Exposure Index, an additional indicator, i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE), on average over a year, as outlined in the aforementioned TG-Noise methodology (2022). For the calculation of the Exposure Index, it is necessary to account for the propagation of noise from the source (either by modelling or other methods such as applying a buffer zone) and consider the footprint of an impulsive noise event, where the footprint is limited by the isoline at which the LOBE is reached.

104. Despite the finalisation of the EU TG-Noise methodological framework and its approval at the EU level, the process of data production and gathering has started too recently. Hence, the quantity and quality of available data prevented optimal implementation of above explained methodology. Therefore, the adapted methodology was applied within the preparation of the 2023 MED QSR whenever necessary to fit data available for underwater noise pollution. This is the first such assessment of anthropogenic pressures from noise regarding both the IMAP and the MSFD implementation in the Mediterranean Sea.

2.5.9. The Environmental Assessment methodology applied for assessment of IMAP Candidate Common Indicator 27 (cCI27)

105. The assessment of cCI 27 i.e. "continuous low frequency sound" is performed in collaboration of the ACCOBAMS and the UNEP/MAP - MED POL based on data obtained from the NETCCOBAMS Platform, a digital tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The platform contains maps of shipping noise distribution over the entire Mediterranean basin. These were obtained from modelling techniques in the frequency bands of interest further to the requirements set out in the Proposal of the IMAP Guidance Factsheet for cCI27.

106. The NETCCOBAMS platform was established, based on a specific request from the Contracting Parties to the ACCOBAMS, back in 2012 during a regional workshops on the 'ACCOBAMS Strategy', in order to set up a tool aimed at centralizing relevant data and support science-based decision making. The NETCCOBAMS noise mapping service delivers information to be used by the Parties, by the Secretariat and further by the ACCOBAMS bodies and stakeholders to pursue objectives under the scope of the ACCOBAMS Agreement (ACCOBAMS-MOP8/2022/Doc31/Annex13/Res8.7). However, the processes specifically related to IMAP GES assessment (e.g., data reporting and validation from the countries, aggregation, etc.) have been set up very recently in 2022 and are still subject to change. This prevents a full implementation of the GES assessment methodology. Nevertheless, an initial assessment was carried out within the 2023 MED QSR preparation as the quality of available data was sufficient and allowed to produce the first assessment findings for the four Sub-regions of the Mediterranean Sea.

107. For the initial assessment of the noise within the preparation of the 2023 MED QSR, the methodology applied for assessment of the cCI 27 served as an indication of the anthropogenic pressures. Further, by including information about the habitat of noise-sensitive species, it was possible to move towards the assessment of whether the risk of that negative impacts occurring on populations of such species is acceptable. Specifically, the methodology for cCI27, which was based on monthly Exposure Index, i.e., the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE) on a monthly basis, ensured addressing the risk of extinction of a population due to exposure to underwater noise. This concept is at the basis of the noise assessment methodology developed by the TG-Noise under the scope of the MSFD-D11 with the active contribution of ACCOBAMS and SPA/RAC.

108. Like for cCI26, the collaboration of the ACCOBAMS and the UNEP/MAP - SPA/RAC allowed to consider specificities of the Mediterranean Sea and ensure applicability of the assessment methodology developed under the scope of MSFD-D11 also for an initial assessment of IMAP cCI 27. The assessment methodology conceived is compatible with the initial proposal of the IMAP Guidance Fact sheets for cCIs 26 and 27 (UNEP/MAP – MED POL, 2019) which were presented for consideration of the Meeting of MED POL Focal Point (Istanbul, Turkey, 29-31 May 2019), prepared in line with the Monitoring strategy of ACCOBAMS issued in 2015 (Maglio et al, 2014, ACCOBAMS, 2015).

109. The Proposal of IMAP Guidance Factsheet for cCI 27 indicates the following target: “the extent (% or km²) of the assessment area which is above levels causing disturbance to sensitive marine animals is below limits”. Further to the finalisation of the work from EU TG-Noise in 2022, it is found that this GES target still stands. Therefore, it was applied for the initial cCI 27 assessment within the preparation of the 2023 MED QSR.

110. Particularly, under TG-Noise methodology approved at EU level, Tolerable Status is defined when 20% or less of the habitat of noise-sensitive species is impacted by continuous noise on a monthly basis (average over 1 month). The monthly basis implies that if any month within a year is above this threshold, the environmental status is judged not tolerable for the whole year. This threshold (20%) is valid for all MSFD regions and subregions. Therefore, it was also followed for all IMAP Sub-regions in the Mediterranean Sea within the present initial cCI 27 assessment. This also corresponds to the recommendations made at EU level. Therefore, the initial assessment findings for cCI 27 within the 2023 MED QSR were provided for the four Sub-regions of the Mediterranean Sea i.e. the Aegean and Levantine Sea, the Adriatic Sea, the Central Mediterranean Sea and the Western Mediterranean Sea Sub-regions.

111. For the indicator calculation it is necessary to produce noise maps in the frequency bands as outlined in IMAP Guidance Factsheet for cCI27. However, some adaptations were necessary to perform an initial assessment. In particular, noise maps are to be produced monthly to allow calculation of a monthly Exposure Index, i.e. the extent of habitat of noise-sensitive species which is above the Level of Onset of Biological Effects (LOBE) on a monthly basis, as outlined in the aforementioned TG-Noise methodology (2022).

112. Despite some lacks in the definition of the assessment process, especially concerning the data gathering and aggregation process, the available data on shipping noise produced through the NETCCOBAMS platform, managed by ACCOBAMS, allowed an optimal application of the assessment methodology for 1 month of shipping noise i.e. in July 2020 for the four sub-regions of the Mediterranean Sea.

113. Given the relative stability of ship traffic levels and characteristics over a few years, and that the ship traffic is at the highest level during the Summer period, the assessment produced for month of July 2020 can be generalized to other years, and can be seen as the worst scenario within a year. This is the

first such assessment of anthropogenic pressures from noise regarding both the IMAP and the MSFD implementation in the Mediterranean Sea.

2.6. Assessment Criteria

114. In line with Decision IG.23/6, the Contracting Parties and the Secretariat are encouraged to test the following updated assessment criteria for indicative purposes in the different contexts that exist in the Mediterranean: i) BAC and EAC for trace metals (Cd, Hg, Pb) in sediments and in biota (mussel and fish); ii) BAC for PAHs in biota (mussel); iii) EAC for organochlorinated compounds in sediment and iv) BAC and EAC for biomarkers in mussel. In addition, the Decision IG. 23/6 maintained the following assessment criteria as endorsed by the Decisions IG.22/7 (Athens, Greece, February 2016): i) EAC for sediments and mussel; ii) EAC for a group of organochlorinated compounds in sediment and biota (mussel and fish) complementing updated values and iii) BACs and EACs for biomarkers in mussel, complementing updated values.

115. Hence new available monitoring data were used to update sub-regional Mediterranean BAC values for heavy metals in biota and sediment in 2019 (UNEP/MAP -MED POL, 2019) in order to contribute to preparation of the State of Environment and Development Report 2019 (SoED).

116. In line with the Programme of Work 2020-2021 adopted by COP21 (Naples, Italy, December 2019) and the Programme of Work 2022-2023 adopted by COP22 (Antalya, Turkey, December 2021), and conclusions of the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (Podgorica, Montenegro, 2 - 3 April 2018), the MED POL Programme has undertaken further actions aimed at harmonization and standardization of the monitoring and assessment methods related to IMAP Pollution and Marine Litter Cluster , including the present upgrade of several assessment criteria.

117. The upgraded BC and BAC values for IMAP Common Indicator 17 and possible approaches for upgrade of EAC for IMAP Common Indicators 17, 18 and 20 were considered and approved by the the Meeting of CORMON Pollution (27 and 30 May 2022) (UNEP/MAP – MED POL, 2022). Their calculation was based on new national monitoring data received up to December 31st, 2021, that have not been previously used for the calculation of the assessment criteria in the 2017 and 2019 assessments.

118. In addition, following the recommendation of the OWG on Contaminants, data since 2015 were used as well in the calculation, even if used in the previous assessment. The upgraded criteria were approved in terms of a) using upgraded BC and BAC values for IMAP Common Indicator 17 as well as EAC values for IMAP Common Indicator 20 for Good Environmental Status assessment within the preparation of the 2023 MED QSR; and (b) applying the approaches proposed for future upgrades of EAC values for IMAP Common Indicators 17, 18 and 20 that will take place as of 2024.

119. The Meeting of CorMon Pollution Monitoring recommended to MED POL FPs Meeting, which will be held in May 2023, to take note of the values of upgraded assessment criteria for IMAP Common Indicator 17, with a view of their use for GES assessment within the preparation of the 2023 MED QSR.

120. The Meeting of CorMon Pollution Monitoring also agreed to continue applying the assessment criteria for biomarkers as set by Decisions IG. 22/7 (COP 19) and IG. 23/6 (COP 20) given a lack of data reporting for IMAP Common Indicator 18.

121. Based on recommendations of the Meeting of CORMON Pollution (26 - 28 April, 2021), EAC values for IMAP Common Indicator 20 were approved by the Meeting of CORMON Pollution held on 27 and 30 May 2022 (UNEP/MAP MED POL, 2022) in terms of their use for GES assessment within the preparation of the 2023 MED QSR. They are based on the concentration limits for the contaminants regulated in EU Commission Regulations (EC) No 1881/2006, (EC) No 835/2011 and EC No 1259/2011.

122. Given the relevance of the assessment criteria as provided in Decision IG.20/9 Criteria and Standards for bathing waters quality in the framework of the implementation of Article 7 of the LBS

Protocol, COP 17, Paris, 2012 (UNEP/MAP, 2012), they were used for preparing the initial assessment of IMAP CI 21.

123. Decision IG.23/6 also encourages the Contracting Parties and the Secretariat to test the assessment criteria related to coastal water types reference conditions and boundary values in the Mediterranean as endorsed by the Decisions IG.22/7 (Athens, Greece, February 2016). Furthermore, it is requested to develop region-wide harmonized criteria for reference conditions and threshold/boundary values for key nutrients in water column, taking account of available standards for coastal waters and use of data stored in other databases where some of the Mediterranean countries regularly contribute. To that effect, the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (April 2019), considered data availability for setting the assessment criteria for nutrients and consequently recommended to the Secretariat to undertake actions to set the reference conditions not only for chlorophyll *a*, but also for nutrients, transparency and oxygen, as minimum requirements.

124. In that regard and in line with the Programme of Work 2020-2021 adopted by COP21 (Naples, Italy, December 2019), the MED POL Programme has undertaken further actions aimed at harmonization and standardization of the monitoring and assessment methods related to IMAP Pollution and Marine Litter Cluster, including work aimed at proposing reference conditions and boundary values for nutrients. Considering the evolving nature of data reporting, the Meeting of the CorMon Group on Pollution Monitoring (26-28 April 2021) agreed to recommend use of proposed methodological approaches for setting the reference conditions and boundary values for Dissolved Inorganic Nitrogen (DIN) and Total Phosphorous (TP) in relevant sub-areas, as a basis for progressing towards setting the assessment criteria for DIN and TP (UNEP/MAP MED POL, 2021).

125. Further to the discussion related to a practical application of the methodological approach relevant for the Adriatic Sea Sub-region, which took place during the Meeting of the CorMon Group on Pollution Monitoring (26-28 April 2021), the resumed session of the Meeting of MED POL Focal Points (9 July 2021) and the 8th EcAp Coordination Group Meeting (9 September 2021), the reference and boundary Values for DIN and TP in the Adriatic Sea Sub-region were elaborated and approved (UNEP/MAP MED POL, 2022) by the Meeting of CORMON Pollution (27 and 30 May 2022).

126. Due to nitrogen/phosphorus limitations present in the Mediterranean (i.e. restricted measurements of Dissolved Inorganic Phosphorous - DIP), as well as due to limited data availability and related demanding statistics, it was possible to propose only the reference conditions and G/M boundary values as annual G_Mean for Chl*a*, TP, DIN in the Adriatic Sea Sub-region coastal and open (offshore) waters. The Meeting of CORMON Pollution approved such proposed assessment criteria in terms of using the values calculated for the reference conditions and G/M boundary values as annual G_Mean for TP and DIN in the Adriatic Sea Sub-region coastal and open (offshore) waters, as well the values of the G/M boundaries for Chl*a* in the Adriatic Sea Sub-region coastal waters as approved in IG.22/7 (COP 19).

127. The use of the new criteria was agreed upon in terms of their use for the Good Environmental Status assessment of the Adriatic Sea Sub-region within the preparation of the 2023 MED QSR. The Meeting recommended to MED POL FPs Meeting, which will be held in May 2023, to take note of the values of upgraded assessment criteria for IMAP Common Indicators 13 and 14, with a view of their use for GES assessment in the Adriatic Sea Sub-region.

128. Data from 2015 onwards were included for the calculation of the reference and boundary values for TP and DIN in the Adriatic Sea Sub-region. The data available for Chl*a* from remote sensing i.e., from Copernicus 1x1 km grid), for the period April 2016 – March 2021 were used to integrate areas where systematic lack of data where found in IMAP Info System or data were insufficient for appropriate calculation of the reference and boundary values for Chl*a*).

3. Drivers, Pressures, State, Impact, Response (DPSIR) [15]

3.1 The DPSIR findings related to IMAP Pollution Cluster

129. The methodology for integration of assessment results within the DPSIR approach was elaborated (UNEP/ MAP – MED POL 2021) further to the discussion that took place during the the Meeting of CorMon on Pollution Monitoring and the Meeting of MED POL Focal Points held in 2019 and 2021, respectively. The two approaches were introduced to guide comparison/connecting the known pressures/drivers already defined by expert judgment for a specific assessment with the GES assessment results obtained by applying the GES/Environmental assessment methodologies tested and agreed for application for the specific Common Indicators.

130. The methodology builds on the work undertaken to map the interrelations between sectors, activities, pressures, impacts and state of marine environment for EO5 and EO9 (UNEP/MAP – MED POL, 2019). The interactions between pressures and impacts for EO5 and EO9, as measured by IMAP Common Indicators, is shown in Table I. (Annex IV (CH 3)). They are presented in the GRID/Table approach that takes into account the geographical scales for the assessment to the sub-division level (Section 3.1.1). The interrelations served as a basis for proposing the GES/Environmental Assessment methodologies for IMAP CIs, as well as the approaches aimed at interrelating the DPSIR and GES assessment findings.

3.1.1 The GRID/Table approach

131. The GRID/Table approach 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 colour 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 (Table I, Annex IV (CH 3)). 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. A direct simple comparison between the GES assessment results and the degree of pressures as provided in the GRID Table for each spatial assessment unit is considered useful. Therefore, Table II, Annex IV (CH 3)). provides an update of the GRID/Table approach that was elaborated in previous UNEP/MAP documents and considered a starting point towards the 2023 Med QSR. 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 agreed for assessment of specific CIs. The assessment result (GES or non-GES) may be given according to a quality status colour scale or scale of scores. By complementing the GRID/Table with assessment results, a direct comparison of the

[15] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:
- Provide the overall common DPSIR analysis for the whole IMAP, which combines all CIs and respective EOs
- Within the GES assessment elaborated per individual CI, (a) identify the DPSIR findings that are most relevant for the CI and (b) interrelate DPSIR findings with GES assessment findings (matrix for Pollution Cluster is presented below; table 6), where feasible and appropriate.
- Note where detailed elaboration of key pressures/impacts–state interrelationship according to this DPSIR is not feasible, provide a detailed explanation of the reasons in the following chapters related to GES assessmentNote: Use the results of work undertaken so far: (i) DPSIR analysis prepared within the cross-cutting document (2017), as well as for preparation of ICZM Framework; (ii) DPSIR analysis provided for the IMAP Biodiversity cluster; (iii) using relevant findings from UNEP/MAP and external processes; (iv) joint UNEP/MAP – EEA joint report, SoED, Mid-term NAPs evaluation related to LBS Protocol and NAPs related to biodiversity, TDA preparation, etc.

environmental status to the known pressures for a specific area can be made following the DSIR approach.

132. 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 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.

3.1.2 The Framework for Vulnerability Assessment

133. There are several other methodological approaches, in addition to the GRID/Table approach, 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), including application of defined quality threshold values (i.e. categorizations and values assignment). An example of such approach was piloted in Boka Kotorska Bay (Montenegro) within the CAMP, 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). 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.

3.1.3 The DPSIR Analysis undertaken in 2019, based on SCOREBOARDS METHOD: Quantifying pressures/impacts relationships

134. Following the recommendation of the Meeting of CorMon on Pollution Monitoring (April 2019), GRID/Table Approach, risk-based and the semi-quantitative approaches should be complemented with the modelling of the monitoring data in order to ensure a more reliable quantification of the magnitude of impacts. The vulnerability assessment and mapping of distribution of pressures and impacts over different ecosystem components (species groups, pelagic or benthic habitats) may be considered to support scientifically based scoring.

135. In the absence of quantitative assessment criteria, semi-quantitative approaches should be a basis for mapping and quantifying the interrelation of drivers-pressures-impacts-state-responses relying on the best available expert judgment (UNEP/MAP MED POL, 2019). At stage when monitoring and assessment scales of IMAP were updated/agreed and tested, as well as aggregation and integration rules fully defined, the semi-quantitative scoreboards method was useful for mapping the interrelation of drivers-pressures-impacts-state-responses of complex processes, such as those present in the marine environment (e.g. considering in the vertical axis the economic activities and the natural elements that have great relevance according to the ICZM Protocol and other Barcelona Convention`s Protocols, whilst in the horizontal axis the EcAp/IMAP EOs and CIs). Scoreboards method should provides insights on impacts, which are directly relevant to the state-based assessment of the ecosystem with sufficient detail (e.g. impact on non-commercial species by incidental by-catch which would need to be separated into at least the specified species groups of birds, mammals, reptiles and fish; and preferably at species level, to feed into species-level assessments). The state-based integrated assessments, combining the state-based Common Indicators as a set of ecosystem elements in a holistic manner, should cover the overall pressure-based Common Indicators affecting it (e.g. the state assessment of the benthic ecosystem should evaluate together the impact from the pressures such as physical loss, physical disturbance, non-indigenous species, nutrient enrichment, removal of species and others). Therefore, this level of detail

based on the IMAP EOs and CIs should be the primary methodological basis to develop scoreboard, as well as assign scores, while relying on the best available expert judgment.

136. The added value of the combined synthesis of the semi-quantitative approaches and expert judgment is a clear vision on the requirements and responsibilities from both the managerial and measurement systems. Table III, Table IV, Annex IV (CH 3) detail the activities (originated by main drivers) which are commonly known and aligned with the current IMAP multidimensional measurement system (with their Ecological Objectives and Common Indicators) to address current scenarios of Pressures-State-Impacts. An extension of this interrelation was also provided (UNEP/MAP, 2019), relating specifically IMAP, as the measurements system of the Barcelona Convention with relevant responses provided through relevant regional policies.

137. Moreover, for each chain of elements part of the analysis (Drivers > Activity type > Pressure > State > Impacts (Ecosystem Services, Welfare) > Responses), the table template provides the link to the related Ecological Objective (EOs) and Common Indicators (CIs) of the Barcelona Convention measurement system (i.e. UNEP/IMAP).

138. The above-described approach is then complemented by an Excel tool (see Figure I, Annex IV (CH 3)) which can be used for an expert-based evaluation with different approaches (both item and impact scores). The structure of the Excel file replicates the content of the template provided in Table III, Table IV. proceeding with the same approach for the analysis of the rest of the Drivers and Pressures. The Excel tool could allow simple estimation (in %) of how many items (i.e., Drivers/Pressures from land-based sources) have the potential to pose a threat the marine ecosystem. Experts involved in such evaluation can provide an assessment for each activity type through a 0/1 score: 1 indicating the presence of the potential risk and 0 its absence. The final score is than expressed in percentage, dividing the sum of all scores for the number of scored items (activity types). Moreover, the same Excel tool (Figure 3.1) enables to estimate the magnitude of impacts (in %) by adapting its conceptual objective. Thus, for each Driver/Pressure, experts involved in the evaluation are invited to express a 0 to 3 score: 0 indicating the absence of the impact, while 1, 2 and 3 respectively indicating the presence of an impact with low, moderate and high magnitude. Similarly, in the analysis on the occurrence of potential threats, the final score is expressed in percentage and is obtained by dividing the sum of all scores by the maximum theoretical score (equal to the number of scored items multiplied by 3). The level of detail based on the IMAP Common Indicators and Ecological Objectives should be the primary methodological basis to assign scores.

3.1.4 An overall DPSIR analysis for the Adriatic Sea Sub- region countries

139. The DPSIR analysis for the Adriatic countries is an output of the SIDA project. The analysis is based mostly on qualitative data, however, whenever possible quantitative data publicly available have been used. Data provided by country representatives that participated at the SIDA Project Meeting (10 November 2022, Tunisia) have been incorporated in the analysis. The identification of Responses is presented only in the form of policies. Other type of responses, such as the investments needed, awareness-raising and capacity building activities are not part of analysis below.

140. The structure of the present analysis follows the sequence of the Drivers that appear in the DPSIR matrix. The last section refers to the results of the scoring exercise. The analysis is provided in Annex V (CH 3).

3.1.5 The DPSIR analysis related to IMAP Pollution Cluster

141. Despite methodological development as elaborated here-above, and the interrelations mapped between sectors, activities, pressures, impacts and state of marine environment for EO5 and EO9, DPSIR examination for IMAP Pollution Cluster EOs and CIs could not be provided through integral consideration of GES/environmental assessment findings and DPSIR analysis based on approach elaborated in section 3.1.1. The GES/Environmental assessment results and their evaluation based on a detailed sub-regional DPSIR findings could not be performed due to extreme lack of data on the latter. The CPs did not report in the IMAP-IS information related to the drivers and pressures. Only in a few instances, it was possible to provide DPSIR partial analysis and even less to interrelate the analysis with GES assessment findings.

142. However, present assessments were undertaken, by having in mind

i) the proposed integral approach for consideration of GES/environmental assessment findings;
ii) DPSIR analysis undertaken in 2019, and update undertaken in 2022 for the Adriatic Sea Sub-region, as well as other relevant sources as presented in Sections 3.2 and 3.3;
iii) that the findings presented here below are based on the preliminary DPSIR aspects, as presented in the thematic assessments provided for the preparation of the 2023 MED QSR.

143. The GES/Environmental assessment results were analyzed by also taking account of the drivers, pressures, state and impacts which were mapped in previous UNEP/MAP documents (2019) as presented here-below (Sections 4 and 5), as well as sources from the scientific literature and the results of the GEF Adriatic Project. The relative contribution of the drivers, expected at the CI level, based on expert judgement, was summarized from Table IV (Annex I (CH 3)) (UNEP/MAP MED-POL, 2019), in which red indicates high expected impact; orange indicates moderate impact, yellow indicates mild impact and green indicates no expected impact. In brief, the drivers and their contributions to CIs may be summarized as provided here-below.

144. **Agriculture**: The pressure of agriculture is a result of runoff and rivers discharge that may transport chemicals and pollutants towards the coast and the offshore. This pressure can cause a state of contamination, pollution and eutrophication, impacting the habitat (habitat and ecosystem deterioration) and seafood (contamination). Based on expert judgement, agriculture has a high impact on CIs 13 and 14, a moderate impact on CI17 and a mild impact on CIs18, 20 and 21.

145. **Industry (Land-based sources),** diverse industrial activities. One pressure of industry is the discharge of industrial wastewater (treated and untreated) into the coastal area and its dispersal offshore, causing a state of pollution. The impact is the contamination of seawater, sediment and biota by existing and emerging chemical and possible pelagic and benthic ecosystem deterioration and seafood contamination. A second pressure of industry are the occasional acute events of unplanned, accidental discharge of industrial effluents, affecting the state of the coastal waters impacting natural resources. A third pressure of industry, is the authorized dumping of waste that affect the state of sea-floor habitats by

contamination and impairing its integrity, impacting the benthic ecosystem. Based on expert judgement, industry has a high impact on CIs13, 14, 17, 18 and 20 and a moderate impact on CI21.

146. **Aquaculture.** Coastal shellfish and fish farming activities may cause pressure in the water column and seabed habitats by substances discharged or released from the farms, causing a state of eutrophication and contamination, impacting the habitats with deterioration and impairing biodiversity. Based on expert judgement, aquaculture is considered to have a high impact on CIs 13 and 14, a moderate impact on CI 17 and a mild impact on CIs 18, 20 and 21.

147. **Tourism, sporting and recreational activities**. Urban and real estate development activities increase the pressure in the form of increased waste generation (litter, urban effluents, wastewater treatment plants, microbiological pollution). The state is described as degradation of land, air and water sources, with increased occurrence of pathogens. Impacts can be detected in soil contamination, habitat loss, decrease in bathing water quality. Moreover, the pressure of increased nutrients discharged into the coastal zone may cause a state of eutrophication, impacting habitats and impairing biodiversity. Based on expert judgement, tourism (frequentation, yachting) is considered to have a mild impact on CI21 and no impact on CIs 13, 14, 17, 18 and 20. However coastal urbanization as a result of tourism is expected to have high impact on CIs 13, 14, and a mild impact on CIs 17, 18, 20 and 21.

148. **Utilization of specific natural resources**. Desalination activity causes a pressure in the form of intake of coastal seawater and the release of brine and brackish water to the environment. The state could be a deterioration of the habitats, impacting the integrity of the seafloor, impacting the quality of sea water and habitats, and impairing biodiversity. Based on expert judgement, desalination is considered to have a high impact on CI 13 and a mild impact on CI 14, a moderate impact on CI 17, a moderate impact on CIs 17, 18, and 20 and no impact on CI 21.

149. **Infrastructure, energy facilities, ports and maritime works and structures**. The pressure of acute pollution events and accidental hazardous substances and oil discharge may cause a state in which the quality of the water column and seabed habitats decline together with biodiversity loss. The impact is described a loss of natural resources and endemic species threatened. A second pressure is the input of nutrients and organic matter producing a state with loss of endemic species and habitats, impacting the availability of natural resources. A third pressure is the possibility of microbiological pollution producing a state in which pathogens occur in the environment, impacting and degrading the bathing water quality. Based on expert judgement, these drivers may include dredging, considered to have a high impact on CIs 13, 14 and 17, a moderate impact on CI 18, and 20 and no impact on CI 21. Port operations are expected to have a mild impact on CIs 13 and 14, a high impact on CIs 17 and 18, and a mild impact on CIs 20 and 20 and 21.

150. **Maritime activities.** The activity of offshore platforms (oil and gas exploration) may cause pressure by introducing pollutants (oil hydrocarbons and related organic compounds) with the risk of accidents and spills. Those produce a state with degradation of water and sediment quality degradation and decline in habitats, impacting the health of the coastal waters and habitats. The activity of shipping traffic (commercial, ferries, military, cruise liners) may cause pressure by the introduction of pollutants, litter and noise, causing a state of water column quality and habitats decline impacting the health of coastal water and habitats. An additional pressure of shipping activity is the risk of accidents and acute spills. Those produce a state with degraded water and sediment quality and decline in habitats resilience, impacting the health of the coastal waters and habitats. The activity of solid waste disposal could produce a pressure of unnatural soil, a state in which the soil is polluted, and habitats and species are lost, impacting the health of the coastal zone and decline in benthic habitats. Based on expert judgement, offshore structures are expected to have a moderate impact on CIs 17 and 18 and no impact on CIs 13, 14, 20 and 21. Oil and gas extraction and shipping are expected to have a high impact on CIs 17 and 18, a moderate impact on CI 20 and no impact on CIs 13, 14, and 21.

3.1.5.1 The DPSIR Analysis for IMAP Pollution Cluster Indicators in the Aegean – Levantine Sea Sub-region

Aegean Sea Sub-division

151. **EO 5 - CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** Drivers that could impact CIs 13 and 14 are present in the AEGS: Agriculture, Tourism and maritime activities, Coastal urbanization, Ports operation and maritime traffic.

152. **EO 9 – CI 17 (TM, Σ_{16}PAHs, Σ_5PAHs and Σ_7PCBs in sediments):** Using CHASE+, the AEGS was classified as in-GES for TM in sediments when the contribution of the two very limited affected areas (Elfesis Bay and inner Saronikos Gulf and area near Aliaga and Yenisakran) were not taken into account (see below Sections 4 and 5). It was not possible to classify the AEGS sub-division for Σ_{16} PAHs due to insufficient data while for Σ_5 the AEGS was classified as non-GES. It was not possible to classify the AEGS regarding Σ_7 PCBs in sediments due to insufficient data.

153. Regarding TM in sediments, one of the very limited non-GES area was the Elfsis Bay/ inner Saronikos Gulf. Drivers and pressures in the area are extensive urbanization (metropolitan areas of Athens), Port activities and maritime traffic (Piraeus port), Industries located in the coastal area of the Elefsis Bay, such as oil refineries, steel and cement industries, and shipyards, Discharges of wastewater treatment plant. TM pollution decreased from 1999 to 2018 in some areas due to environmental policy enforcement combined with technological improvements by big industrial polluters (Karageorgis et al., 2020 and references therein). A second limited non-GES area was near Aliaga and Yenisakran. Possible drivers and pressures are port operations, industry, tourism and agriculture.

154. It was not possible to classify the AEGS Sub-division regarding data for Σ_{16} PAHs in sediment due to insufficient data. There are indications that the offshore zone is in GES while the enclosed areas might be found as non-GES. Regarding Σ_5 PAHs in sediments, the AEGS was classified as non-GES. The same limited areas classified as non-GES for TM in sediments are also non-GES for Σ_5 PAHs, with the same drivers and pressures as for TM. Additional stations were found non-GES in the northern and central part of the AEGS, mainly in enclosed areas that are more sensitive to land-based sources pollutants.

155. The AEGS Sub-division could not be classified regarding assessment of Σ_7 PCBs in sediments due to lack of data. An affected, non-GES area was identified in the coast around Aliaga, Yenisakran and Candarli, as for TM. Possible drivers and pressures are port operations, industry, tourism and agriculture.

156. IMPACTS. No data on biota were available for the AEGS. Drivers and pressures that can impact biota were found in the AEGS.

157. **CI 18 - Level of pollution effects of key contaminants where a cause-and-effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI 18, were identified in the AEGS, no data were available at IMAP-IS to check for impacts in biota. Only two relevant studies in the scientific literature reported data on biomarkers in the AEGS, both for Türkiye. Both showed indications of possible effect of TM and/or pesticides on the molluscs *Mytilus galloprovincialis* and *T. decussatus* collected from Homa Lagoon (Aegean Sea) (Uluturhan et al. 2019) and in the fish *M. barbatus, B. boops and T. trachurus* collected off the coast of Türkiye (Dogan et al., 2022).

158. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** See DPSIR assessment for the LEVS sub-division.

159. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** See DPSIR assessment for the LEVS Sub-division.

<u>*Levantine Sea Sub-division*</u>

160. **EO5 - CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chl*a* – Chlorophyll a):** Drivers that could impact CIs 13 and 14 are present in the LEVS: Agriculture, Tourism and maritime activities, Coastal urbanization, Desalination, Ports operation and maritime traffic, gas and oil exploration.

161. The complete assessment of the environmental status of the AEL Sub-region for CIs 13 and 14 was not possible given the lack of quality-assured, homogenous data that prevented the application of both EQR and simplified EQR assessment methodologies (Section 2). Therefore, at this stage of 2023 MED QSR preparation, the assessment of eutrophication was performed by evaluating data only for Chl*a* available from the remote sensing COPERNICUS data and only for the Levantine Sea (LEVS) sub-division (Sections 4 and 5). The assessment results show that all evaluated assessment zones can be considered likely in GES regarding satellite derived Chl*a*.

162. Detailed examination showed that only 1 out of 18 SAUs, in the open waters (OW), was classified as likely in non-GES. The SAU is located in the easternmost part of the southern Levantine Sea. The drivers and pressures in this SAU that could impact CI 14 are related to the area being one of the most densely populated areas in the world. Moreover, untreated or partially treated wastewater are discharged along the shoreline, polluting the coastal zone (Abualtayef et al., 2016).

163. **EO 9 – CI 17 (TM in sediments and biota, Σ_{16}PAHs, Σ_5PAHs and Σ_7PCBs in sediments):** Using CHASE+, the northern and eastern (NE) LEVS was classified as in-GES for TM in sediments, when the contribution of the two very limited affected areas (off Haifa and off Beirut, see below in Sections 4 and 5) were not taken into account. No assessment could be performed for the southern LEVS as no data were available. The NE LEVS was in-GES for Σ_{16} PAHs in sediments in Israel, Greece and Lebanon and in-GES for Σ_5 PAHs in sediments in Israel, Greece and Türkiye. The LEVS could not be classified based on assessment of Σ_7 PCBs in sediments due to lack of data and their uneven spatial distribution.

164. Regarding TM in sediments, non-GES stations were identified across the NE LEVS as follows: 1) In Israel, Northern Haifa Bay was non-GES (moderate status) and the main element contributing to this classification was Hg. The area is known to be still contaminated by legacy Hg, a pressure resulting from industry driver by ways of contaminated wastewater discharge. Even though there was a vast improvement following pollution abatement measures (Herut et al, 2016, 2021), the area is still contaminated; 2) In Lebanon, the main area in non-GES (moderate and poor) was off Beirut, in particular the Dora region, followed by area in the North Lebanon, with Cd and Hg concentrations contributing

equally to the moderate classification. In Beirut, the drivers contributing to the pressures and state of the coast are urban development and industry, discharge of wastewater through marine outfalls and by riverine discharge of the Beirut River. In addition, dumpsites are present in the Dora region (Ghosn et al., 2020). Tripoli, in northern Lebanon, is known for its artisanal fishing and boat maintenance activities (Ghosn et al., 2020), the latter a driver for TM introduction.

165. Stations in moderate status regarding TM in sediments were found in Cyprus in Larnaka Bay, off Zygi and in Chrisochou Bay Possible drivers are tourism and maritime activities, port operations among others. In Greece, two stations were found in moderate status (Koufonisi (S. Crete), Kastelorizo), with Pb and Cd concentrations contributing to this classification. Possible drivers are maritime activities and traffic, and fishing. In Türkiye, 4 stations were classified as in moderate status: Akkuyu, Taşucu, Anamur, Göksu River mouth. Possible drivers are agriculture, marine activities, riverine discharge.

166. Although the areas with data for Σ_{16} PAH in sediments were overall characterized as in-GES, the two geographically limited areas with non-GES status were identified. In Israel, at stations close to the locations of drilled wells for gas exploration (Astrahan et al., 2017). The driver was defined as maritime activities, offshore platforms of gas exploration. In Lebanon, off in Beirut. The same drivers contributing to the status of TM in sediments apply also for Σ_{16} PAH.

167. The LEVS sub-division could not be classified based on assessment of Σ_7 PCBs in sediments due to lack of data and their uneven spatial distribution. The Dora region off Beirut was affected with possible drivers similar to TM in sediments: urban development and industry, discharge of wastewater through marine outfalls and by riverine discharge of the Beirut River.

168. IMPACTS. Although drivers and pressures and non-GES statuses were identified for the CI 17 in the LEVS, essentially no impact was detected in the environmental status classification fish and the NE LEVS was classified as in-GES for TM in *M. barbatus*. The only non-GES station (1 out of 15) in poor status was located off Paphos, Cyprus and this classification was due to the concentration of Hg. No data were available for TM in sediments in this area. It should be emphasized, that concentrations not in-GES do not necessarily imply a biotic effect.

169. **CI 18- Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI18, were identified in the LEVS, no data were available at IMAP-IS to check for impacts in biota. Only two relevant studies in the scientific literature reported data on biomarkers in the LEVS. Both showed indications of possible effect of TM on various biomarkers in the mussel *Ruditapes* decussatus from Port Said (Egypt) (Gabr et al. 2020) and in the fish *M. barbatus, B. boops and T. trachurus* off the coast of Türkiye (Dogan et al., 2022).

170. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** The CI 20 DPSIR analysis was performed at the level of the entire AEL Sub-region due to the lack of data for the separate analysis of LEVS and AEGS Sub-divisions. Drivers that could exert pressure and cause impact on CI 20 were detected in the AEL. The examination of CI 17 results showed no impact on biota in the LEVS and not data reported for biota in the AEGS. In addition, data reported to IMAP-IS for CI 17 for biota in the LEVS were examined based on the concentration limits for the regulated contaminants in the EU, concentrations higher than those used for the CI 17 assessment. No impact was detected on CI 20.

171. Out of the 23 studies found in the literature for the AEL, 87% reported concentrations of TM and organic contaminants below the concentration limits for the regulated contaminants in the EU, 4% reported concentrations above the limits but without risk to human health and 9% reported concentrations above the limits for the regulated contaminants with probable risk to human health.

172. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** The CI21 DPSIR analysis was performed at the level of the entire AEL Sub-region due to the lack of data for the separate analysis of LEVS and AEGS Sub-divisions. Drivers that could exert pressure and cause impact on CI 21 are present in the AEL, among them: Urban coastal development, Tourism, sporting and recreational activities; ports and maritime works, maritime activities. However, data were available only for Israel (2021) and Lebanon in 2019-2021 in the LEVS. All stations in Israel were in excellent category. In Lebanon, 4 out of 38 stations were classified in bad category, all in the Beirut area. Possible drivers are urban development and industry, discharge of wastewater through marine outfalls and by riverine discharge.

3.1.5.2 The DPSIR Analysis for IMAP Pollution Cluster Indicators in the Adriatic Sea Sub-region

173. **EO 5 – CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** The detailed status assessment results show that all the SAUs achieve GES conditions (high and good status). For all three parameters, the results show that all SAUs and sub-SAUs are in GES. The only exceptions are the results for TP in a part of CAS in the Italian offshore coast (Abruzzo region), and the TP on the SAS coastal and offshore zones (Apulia region), that were classified in moderate status. The Abruzzo and Apulia regions were identified as having aquaculture and coastal and maritime tourism (Gissi et al., 2017). Both drivers were identified as high impact to CIs 13 and 14 (Table I, Annex IV (CH 3)). Nutrients might be introduced to the area causing pressure and have the possibility to cause eutrophication and impact habitats and biodiversity. In the case of moderate status for TP, it was a localized effect, not affecting the overall assessment status and all SAUs fall under the GES status (high, good). A natural process of nitrogen limitation in the area and subsequent accumulation of phosphorus may be an additional explanation to the moderate assessment. Although the two drivers, aquaculture and coastal and maritime tourism, are present in other areas of the Adriatic Sea, they did not impact CI 13 nor CI 14, as represented by the available data.

174. **EO 9 – CI 17 (TM in sediments and biota, Σ_{16}PAHs in sediments and Σ_7PCBs in sediments and biota):** Overall, the aggregation of the chemical parameters data per SAU in the Adriatic Sub-region classified 80% of the SAUs as in GES (High or Good status), and 20% of the SAUs as non-GES under moderate status.

175. The detailed status assessment results per contaminant per SAU at the 1st level of assessment (no aggregation or integration) showed that in most cases (80% of SAUs) GES conditions are achieved; 9% of the SAUs are classified in moderate status, 6% in poor status and 5% in bad status.

176. For the sediment matrix, the highest contamination is observed from PCBs, PAHs and Hg resulting in non-GES status for 60%, 57% and 27 % of the sub-SAUs, respectively. For the mussels matrix, the highest contamination is observed from PCBs which results in 39% of sub-SAUs in non-GES status.

177. In the NAS, 19% of sub-SAUs are classified as non-GES. The most affected sub-SAUs in the NAS are HRO-0313-BAZ, HRO-0412-PULP and HRO-0423-RILP in Croatia; Emiglia-Romana', 'Fruili-Venezia-Giulia-1' and 'Veneto-1' in Italy. Also, offshore SAUs IT-NAS-O and MAD-Sl-MRU-12 are affected. The NAS subdivision suffers from Hg contamination (moderate status) in sediments and mussels and PCBs (poor status) contamination in sediments

178. In the CAS, 12% of the SAUs are classified as non-GES. The most affected sub-SAUs are HRO-0313-KASP, HRO-0313-KZ, HRO-0423-KOR in Croatia. The CAS sub-division suffers from Hg (poor status) and PCBs (moderate status) contamination in mussels

179. In the SAS, 22 % of the SAUs are classified as non-GES. The most affected SAUs are HRO-0313-ZUC, HRO-0423-MOP and HRO-0313-ZUC in Croatia; and MNE-1-N, MNE-1-C, MNE-1-S,

MNE-Kotor, in Montenegro which are found in poor or bad conditions regarding several contaminants. The SAS sub-division is affected by Pb (moderate status) and PCBs (moderate status) contamination in mussels.

180. The main drivers that could put pressure on TM in sediments are industry (waste discharge and dumping of waste), tourism (litter, domestic waste water discharge), ports and maritime works (accidental discharges, dredging), shipping traffic (accidental discharges, solid waste disposal). Shipping traffic is extensive in the Adriatic Sea. In addition, Gissi et al., 2017 identified coastal and maritime tourism in Abruzzo, Apulia, Emilia Romagna, Marche, Molise, Veneto and Slovenia, although tourism is well developed in Croatia as well. They also identified dumping area for dredging in Emilia Romagna. See also Annex V (CH 3) with an extensive study on the DPSIR in the Adriatic Sea.

181. In the southern Adriatic Sea, Albania's coast and offshore SAUs are non-GES concerning Hg in sediments. In Montenegro, Hg, Pb, Σ_{16}PAHs and Σ_{7}PCBs in sediments were classified as non-GES in the central coastal SAU as well in the Kotor Bay. The project GEF (*Global Environment Facility):* Adriatic Implementation of the Ecosystem Approach in the Adriatic Sea through Marine Spatial Planning, examined in detail the DPSIR elements for Albania and Montenegro marine environment. Those support the results of the NEAT assessment achieved with IMAP monitoring data. In Albania, about 15% of the coastline is urbanized, and tourism is increasing (drivers and pressure). <u>Status.</u> The initial assessment of pollution shows established significant concentrations of mercury and organochlorinated compounds in some of the assessed areas on the northern and central coast (status). In Montenegro, about 32.5% of the coastline is urbanized, while tourism consists mainly beach goers. Nearshore activities, such as shipyards and ports are also of concern (drivers and pressures). <u>Status.</u> The preliminary assessment of pollution shows higher concentration of contaminants in the coastal area, particularly in Boka Kotorska Bay. The levels of some contaminants exceed the established limit, specifically legacy pollutants such as heavy metals and organohalogen compounds in sediments.

182. IMPACTS. Although drivers and pressures and non-GES statuses were identified for CI 17 in the Adriatic Sea, a few impacts were detected in the environmental status classification of the biota. Moreover, the non-GES status of a contaminant in the biota usually did not correspond to a non-GES status for the contaminant in sediment in the same sub-SAU. In the NAS, sub-SAUs for biota were in non-GES status for Hg and PCBs, with no corresponding non-GES status in the sediment or no data for PCBs in sediments. In 3 instances there was a correspondence between non-GES status for Hg in biota and sediment. In several sub-SAUs, Pb in sediments were non-GES while in-GES in biota. In the CAS there was no correspondence between the status of the sediments and the status of the biota. In the SAS, for 2 sub-SAUs, non-GES status for Pb in sediments corresponds to non-GES status for Pb in biota.

CI 18 - Level of pollution effects of key contaminants where a cause and effect relationship has been established: Although drivers, that could exert pressure and cause impact on CI 18, were identified in the Adriatic Sea, no data were available at IMAP-IS to check for impacts in biota. One study from the scientific literature reported impact of PAHs on some of the biomarkers measured in the specimens of the fish *Mullus barbatus* collected in an important fishery area in the North Adriatic Sea coming from Rimini to Ancona at a depth of 70 m (Frapiccini et al. 2020).

183. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** Drivers that could exert pressure and cause impact on CI 20 were detected in the Adriatic Sea Sub-region. The examination of CI 17 results showed no impact on biota. In additions, data reported to IMAP-IS for CI 17 for biota were examined based on the concentration limits for the regulated contaminants in the EU, concentrations higher than those used for the CI 17 assessment. No impact was detected on CI 20.

184. Out of the 25 studies found in the literature, 80% reported concentrations of TM and organic contaminants below the concentration limits for the regulated contaminants in the EU, and 8% reported

concentrations above the limits but without risk to human health. Possible impact was detected in 12% of the studies that reported concentrations above the limits for the regulated contaminants with probable risk to human health.

185. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** Drivers that could exert pressure and cause impact on CI21 were detected in the Adriatic Sea, and among them the following: Tourism, sporting and recreational activities; ports and maritime works, maritime activities. However, essentially no impact was detected. Most of the bathing waters in the Adriatic were in the excellent and good GES classifications. A small percentage of bathing waters were classified as poor: 1.7% in Italy and 3.5% in Albania.

3.1.5.3 The DPSIR Analysis for IMAP Pollution Cluster Indicators in the Central Mediterranean Sea Sub-region

186. **EO 5 - CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chla – Chlorophyll a):** Drivers that could impact CI 13 and CI 14 are present in the CEN: Ports operation and maritime traffic, Tourism and maritime activities, Coastal urbanization, Desalination, Agriculture.

187. **EO 9 – CI 17 (TM, Σ_{16}PAHs, and Σ_5PAHs in sediments):** It was not possible to classify the Sub-region based on the CHASE+ application due to very limited available data and they uneven areal distribution in the CEN. The assessment was performed by station. Most of the stations were in-GES with respect to TM in sediments. Stations with non-GES status for Σ_{16}PAHs and Σ_5PAHs in sediments were identified.

188. Non-GES stations regarding Σ_5PAHs in sediments were located at the north-eastern and south-eastern part of Malta, in particular at the Port il- Kbir off Valetta and at the Operational Wied Ghammieq. Drivers and pressures in these areas are industrial plants and marine traffic. Non-GES stations were also located at the in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki.

189. IMPACTS. Drivers and pressures and non-GES statuses were identified for the CI17 in the CEN. However, there were almost no data for contaminants in biota in the CEN. Eight samples of *M. galloprovincialis* were in-GES for TM and 5 samples of *M. barbatus* were classified as non-GES for Hg.

190. **CI 18 - Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI18, were identified in the CEN, no data were available at IMAP-IS to check for impacts in biota.

191. Examination of the scientific literature on the impact of pollution on biota biomarkers in the CEN found 5 studies for Tunisia and 1 from Italy. Drivers and pressures reported in the studies, encompassed the whole range of them: domestic and industrial discharges, agricultural and riverine runoff, fisheries, harbor and marina utilization, maritime activities, tourism. Studies demonstrated that, in addition to anthropogenic stressors, biomarker responses were influenced also by seasonality, tissue analyzed, spawning status, and on species identity.

192. It should be emphasized that the studies used different biomarkers, with different biota species, measuring in different tissues, and different methodologies. The biomarkers studied were not listed by IMAP, and if listed, not analyzed in the organ or tissue as required by IMAP. Most of the studies measured various biomarkers in the same station, with some showing an effect and others not. All the studies below reported an impact on <u>some</u> of the biomarkers. Therefore, the text below addresses only the areas and species studied, and possible specific drivers, if available, with the knowledge that impact was detected in some of the biomarkers.

193. **Tunisia.** One mesocosm experiment was performed in Mytilus spp. exposed to sediment contaminated by PAH and TM collected from the Zarzis area (Ghribi et al. 2020), while the effects of hydrocarbons were studied in the mollusc *Ruditapes decussatus* collected from the southern Lagoon of Tunis (Mansour et al. 2021). The effect of TM on the mollusc *Patella caerulea* was studied in specimens collected from 4 sites in the CEN (Zaidi et al. 2022). The effect of microplastic ingestion was studied in the fish *Serranus scriba* collected from 6 sites along the Tunisian coast (Zitouni et al. 2020) and on the seaworm *Hediste diversicolor* collected from 8 sites along the Tunisian coast (Missawi et al. 2020).

194. **Italy.** The effect of plastic ingestion was studies in the fish *Trachurus trachurus* collected for the Sicily straits (Chenet et al. 2021).

195. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** Drivers that could exert pressure and cause impact on CI 20 were detected in the CEN. TM data were present for Hg in 5 specimens of *M. barbatus* in IMAP-IS. The concentrations were higher than the thresholds for CI17 but lower than the limits for the regulated Hg in the EU. No studies were found in the literature.

196. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards.** Drivers that could exert pressure and cause impact on CI 21 are present in the CEN, among them: Urban coastal development, Tourism, sporting and recreational activities; ports and maritime works, maritime activities. No data were available for CI 21 in IMAP-IS.

3.1.5.4 The DPSIR Analysis for IMAP Pollution Cluster Indicators in the Western Mediterranean Sea Sub-region

197. **EO5 – CI 13 (DIN – Dissolved inorganic nitrogen and TP – total phosphorus) and CI 14 (Chl*a* – Chlorophyll a):** The complete assessment of the environmental status of the WMS Sub-region for CIs 13 and 14 was not possible given the lack of quality-assured, homogenous data that prevented the application of both EQR and simplified EQR assessment methodologies (Section 2). Therefore, the assessment of eutrophication was performed by evaluating data only for Chl*a* available from the remote sensing COPERNICUS data and only for the Alboran Sea (ALBS) sub-division (Sections 4 and 5). The assessment results show that all evaluated assessment zones can be considered likely in GES regarding satellite derived Chl*a*.

198. Detailed examination showed that 4 out of 26 SAUs in the Spanish coastal waters (CW) were classified as likely in non GES: One located near the Gibraltar straits, two located close to the line dividing the CW to the eastern and western part of the assessment zone, and one located close to the Mar Menor lagoon and not far from Cartagena.

199. Drivers and pressures with high impact on CIs 13 and 14 are found in the ALBS: Agriculture (runoff and riverine discharge), Industry (land based sources; industrial wastewater discharge), aquaculture (coastal shellfish and fish farming activities), coastal urbanization and tourism (domestic wastewater discharge), seawater desalination, ports and maritime operations (dredging). Specifically, the Bay of Gibraltar (Bay of Algeciras), one of the likely in non-GES SAUs, is very urbanized and industrialized, and has working ports and extensive maritime traffic. The SAU not far from Cartagena could be impacted by the Cartagena coastal zone, that is under the influence of urban, harbour, industrial and oil-related activities of Cartagena city, as well as by the nearby industrial zone of Escombreras Valley. It is also pressured by multiple stressors emerging from anthropogenic activities, including an intense commercial and recreational shipping activity, naval military and fishing activities (Martinez-Gomes et al., 2017). In addition, pressures could originate from the Mar Menor lagoon, known to be impacted. No specific sources could be identified for the two others likely in non-GES SAUs. They may be connected to local sources of pollution.

200. Some specific examples for drivers and pressures in the ALBS that can be found in the scientific literature: The Oran harbor (Algeria) receives the discharge of wastewaters, while the Ghazaouet harbor is exposed to chemicals coming mainly from industrial activities. In addition, the high rate of urbanization around the harbor contributes to the anthropogenic contamination (Kaddour et al. 2021). Algeria also has seawater desalination plants along its shoreline such as the Bousfer desalination plant in Oran Bay and the Beni Saf desalination plant. Local anthropogenic (industrial, agricultural, and urban) activities are drivers and pressures off Al Hoceima (Morocco) (Azzizi et al., 2021).

201. **EO 9 - CI 17 (TM in sediments and biota (*M. galloprovincialis)* (ALBS); TM, Σ_{16}PAHs and Σ_7PCBs in sediments and biota (TYRS); TM, Σ_{16}PAHs and Σ_7PCBs in sediments and biota (CWMS)):** The assessment was conducted using NEAT in the ALBS and the TYRS Sub-divisions. A simplified application of NEAT (1st level, without any further spatial integration) was applied to the CWMS. Data were available only for some SAUs for the northern coast division (Spain, France, Italy). No data were available for the southern CWMS coast (Algeria and Tunisia). The WMS assessment was made for the coastal zone, as 91% of the data were coastal.

202. Overall, the Alboran Sea (ALBS) and the Tyrrhenian Sea (TYRS) were classified as in GES, in good status regarding all available parameters and SAUs. In the Central Western Mediterranean (CWMS) Sub-division, 6 out of 7 SAUs were classified in high or good statuses and one SAU was classified as non-GES, in moderate status regarding all available parameters.

203. A detailed examination of these classifications is presented here-below.

204. ALBS. The ALBS Sub-division was in GES (high and good statuses) for TM in sediments and for Cd and Pb in biota, and non-GES (moderate status) for Hg in biota sampled along the Spanish coast. In addition, off Morocco, one SAU was in moderate status for Cd in sediments and one in moderate status for Pb in sediments.

205. TYRS. The TYRS Sub-division was in GES (high and good statuses) for TM, Σ_{16}PAHs and Σ_7PCBs in sediments and biota. For the Italian coast several non-GES parameters were identified for some SAUs, as follows: one SAU was in moderate status regarding Cd and Hg in sediments, one SAU in moderate status for Cd in sediments and in poor status for Hg in sediments, and one SAU in moderate status for Cd and Σ_7PCBs.

206. CWMS. Non-GES SAUs for several parameters were identified in the CWMS sub-division as follows: One SAU with moderate Pb in sediment in Spain; in France, one SAU with poor status of Hg in sediments, moderate status for Cd and Hg in biota and poor status for Σ_{16}PAHs in biota; 2 SAUs with poor and moderate statuses for Σ_{16}PAHs in biota; in Italy, one SAU with moderate status for Cd in sediment and poor status for Σ_{16}PAHs and Σ_7PCBs in sediments.

207. Drivers and pressures are found in the WMS: Large Ports and maritime traffic, Coastal urbanization, Tourism, Riverine discharge, Agriculture and aquaculture, Desalination. Some specific examples for drivers and pressures can be found in the scientific literature.

208. IMPACTS. Drivers and pressures and non-GES statuses were identified for CI17 in the WMS however, essentially no impact was detected in the environmental status classification of biota. In the CWMS, for France, moderate status was found for Hg and Pb in biota, at the same SAU with poor status for Hg in the sediment. In addition, moderate and poor statuses were assigned to Σ_{16}PAHs in biota in three SAUs. No concentration of Σ_{16}PAHs in sediment were reported. In the ALBS, for Spain, Hg in biota was in moderate classification. No concentration was reported for Hg in the sediment. It should be emphasized, that concentrations not in-GES do not necessarily imply a biotic effect.

209. **CI 18 - Level of pollution effects of key contaminants where a cause and effect relationship has been established:** Although drivers that could exert pressure and cause impact on CI18, were identified in the WMS, no data were available at IMAP-IS to check for impacts in biota.

210. Examination of the scientific literature on the impact of pollution on biota biomarkers in the WMS found 4 relevant studies from Algeria, 2 from Italy, 5 from Spain and 4 from Tunisia. Drivers and pressures reported in the studies, encompassed the whole range of them: domestic and industrial discharges, agricultural and riverine runoff, fisheries, harbor and marina utilization, maritime activities, tourism. Studies demonstrated that, in addition to anthropogenic stressors, biomarker responses were influenced also by seasonality, tissue analyzed, spawning status, and on species identity.

211. It should be emphasized that the studies used different biomarkers, with different biota species, measuring in different tissues, and different methodologies. The biomarkers studied were not listed by IMAP, and if listed, not analyzed in the organ or tissue as required by IMAP. Most of the studies measured various biomarkers in the same station, with some showing an effect and others not. All the studies below reported an impact on some of the biomarkers. Therefore, the text below addresses only the areas and species studied, and possible specific drivers, if available, with the knowledge that impact was detected in some of the biomarkers.

212. **Algeria:** Mussel *Donax trunculus* from Annaba Bay, from 2 impacted sites (Sidi Salem and Echatt) and one reference site (El Battah) (Amamra et al. 2019); fish, *Mullus barbatus* from two impacted sites (Oran, Ghazaouet) and a control site (Kristel), along the Algerian west coast (Kaddour et al. 2021); mussel *Perna perna* transplanted to three sites in the Gulf of Annaba (Laouati et al. 2021); mussel *Patella rustica* from four sites (3 affected and one reference) off the Bousfer desalination plant (Oran Bay, Algeria) (Benaissa et al. 2020).

213. **Italy:** Fish *Parablennius Sanguinolentus* collected from the port of Bagnara Calabra on the western Calabrian coast of Italy and from a reference site, Jancuia Cove. Stressor – pesticides. (Parrino et al. 2020); mussel, *Mytilus galloprovincialis*, and fish, *Mullus barbatus*, *Pagellus erythrinus* and *Diplodus vulgaris*, from different stations at the Bay of Pozzuoli, within the Gulf of Naples. Stressors: TM and PAHs (Morroni et al. 2020).

214. **Spain:** Three studies conducted near Integrated Multi-Trophic Aquaculture cages in Palma de Majorca as possible driver: two with *Mytilus galloprovincialis*, (Capo et al. 2021; Rios-Fuster et al. 2022) and one with the fish *Sparus aurata* (Capó et al. 2022). In addition, fish, *Seriola dumerili* collected around the Pityusic Islands, (Eivissa and Formentera; Balearic Islands) (Solomando et al. 2022); and European anchovy (*Engraulis encrasicolus*) collected at three areas off Catalonia (Spain): Barcelona, Tarragona and Blanes (Rodríguez-Romeu et al., 2022).

215. **Tunisia**: Scallop *Flexopecten glaber* were collected from the entrance to the Bizerte Lagoon and a site located near Menzel Abderrahmen, contaminated by inputs from the surrounded industrial manufactories and urban agglomerations (Telahigue et al. 2022); polychaete *Perinereis cultrifera* collected from the port of Rades and the Punic port of Carthage, S2 (Bouhedi et al. 2021); fish *Serranus scriba* were sampled from 6 sites along the Tunisian coast (2 WMS and 4 CEN). Stressor, microplastic ingestion as a potential vector for the transmission of adsorbed environmental chemicals to marine organisms (Zitouni et al. 2020); seaworm (*Hediste diversicolor)* from eight sites along the Tunisian coasts (2 WMS and 6 CEN), affected by different anthropogenic stresses. Stressor analyzed – microplastic ingestion (Missawi et al. 2020).

216. **CI 20 - Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood:** Drivers that could exert pressure and cause impact on CI 20 were detected in the Western Mediterranean Sea. The examination of CI 17 results showed no impact on biota. In additions, data reported to IMAP-IS for CI 17

for biota were examined based on the concentration limits for the regulated contaminants in the EU, concentrations higher than those used for the CI17 assessment. No impact was detected on CI-20.

217. Out of the 37 studies found in the literature, 78% reported concentrations of TM and organic contaminants below the concentration limits for the regulated contaminants in the EU and 11% reported concentrations above the limits but without risk to human health. Possible impact was detected in 11% of the studies that reported concentrations above the limits for the regulated contaminants with probable risk to human health.

218. **CI 21 - Percentage of intestinal enterococci concentration measurements within established standards:** Drivers that could exert pressure and cause impact on CI 21 were detected in the Western Mediterranean Sea, and among them the following: Tourism, sporting and recreational activities; ports and maritime works, maritime activities. However, essentially no impact was detected. Most of the bathing waters in Spain, France and Italy were in the excellent and good GES classifications. A small percentage of bathing waters were classified as poor category: 0.1% in Spain, 1% in France, 1.7% in Italy. In Morocco, 20 out of 147 stations (13%) were classified as in bad status. Data were not available for Algeria and Tunisia.

3.2. A Summary of DPSIR findings based in previously adopted UNEP/MAP document

219. UNEP/MAP previous results of work (UNEP/MAP, 2019) on drivers and pressures identified those that can impact the Mediterranean Sea. It should be mentioned that at times, the classification of an element as driver or as pressure is challenging and not well defined. Moreover, the study on the State of the Environment and Development report (UNEP/MAP-Plan Bleu, 2020) states that “the nature of the key drivers of change affecting the Mediterranean basin has not changed significantly in the last few decades. In fact, they persist over time, often in an intensified or even accelerated way which, alongside their cumulative effect, currently drives the change and makes the region very heterogeneous”.

220. The drivers were largely grouped by themes: Demographic trends, Human use, Climate change. Specifically, these general drivers were divided into several categories as shown in Annex VI (CH 3).

3.3. Additional sources describing DPSIR

221. Two additional sources described DPSIR in the Mediterranean Sea: Gissi et al., 2017 and the GEF Adriatic project. Gissi et al., 2017[16] listed the human uses that pressure the Adriatic sub-region and their spatial coverage. They included coastal and maritime tourism; maritime transport; mariculture, small scale fisheries and trawling; oil, gas and sand extraction and offshore platforms; cables and pipelines, dumping sites for dredged spoils, military areas and offshore wind farms.

222. The project GEF (*Global Environment Facility):* Adriatic Implementation of the Ecosystem Approach in the Adriatic Sea through Marine Spatial Planning, examined in detail the DPSIR elements for marine environment of Albania and Montenegro. The level of pressures in marine waters (EO2, EO7, EO9, EO10) were assessed only partially because of insufficient data. Those are described shortly in Annex VII (CH 3).

[16] Gissi, E., S. Menegon, A. Sarretta, F. Appiotti, D. Maragno, A. Vianello, D. Depellegrin, C. Venier and A. Barbanti (2017). "Addressing uncertainty in modelling cumulative impacts within maritime spatial planning in the Adriatic and Ionian region." PLOS ONE **12**(7): e0180501.

4. Good environmental status (GES) / alternative assessment[17]

4.1. The priority themes selected for GES assessment[18]

223. The availability of data and associated application of the assessment criteria and the IMAP assessment methodologies indicated that the following priority themes best reflect IMAP Pollution Cluster assessment findings within the preparation of the 2023 MED QSR towards science-based GES assessment in the Mediterranean:

- Assessment of nutrients and chlorophyll-a;
- Assessment of the contaminants in sediments and biota along with the assessment of contamination effects on biota;
- Assessment of the bathing water quality and contaminants in seafood;

Assessment of the amount and spatial distribution of underwater anthropogenic noise along with the assessment of the habitats affected by noise.

4.2. Assessment of IMAP Common Indicators 13 and 14[19]

Geographical scale of the assessment	Sub-regional based on integration and aggregation of the assessments at sub-division levels
Contributing countries	Croatia, Italy, Slovenia and Montenegro
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicators	CI13. Key nutrients concentration in water column CI14. Chlorophyll-a concentration in water column

[17] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:
- Summary of GES/alternative assessment using a traffic-light system, per CI

[18] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:
- Introduction/ explanation of the theme, including the combination of different CIs and respective EOs
- GES assessment per CI or combination of CIs

[19] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:
This section will be repeated per [Candidate] Common Indicator. The following four points need to be provided per CI:
- Based on the overall analysis as provided in section 3, elaborate those aspects that are most relevant for the individual CI
- Provide and apply the GES assessment methodology per CI that considers spatial and temporal aggregation and integration
- Provide and apply an alternative assessment methodology for those CIs where GES spatial and temporal aggregation and integration is not possible
- Based on the overall analysis as provided in section 3, elaborate the interrelationship of the DPSIR findings that are most relevant for the individual CI and related GES findings, as appropriate and feasible

Note:
For the presentation of CIs for GES assessment / alternative assessment, the methodology should elaborate the use of the criteria of assessment, optimally nested scales of assessment, visualization of the assessment findings by applying the tools as feasible within the selected specific GES assessment methodology i.e., maps/graphs/infographics, etc.

GES Definition (UNEP/MED WG 473/7) (2019)	**CI 13**: Concentrations of nutrients in the euphotic layer are in line with prevailing physiographic, geographic and climate conditions **CI 14**: Natural levels of algal biomass, water transparency and oxygen concentrations in line with prevailing physiographic, geographic and weather conditions
GES Targets (UNEP/MED WG 473/7) (2019)	**CI 13** • Reference nutrients concentrations according to the local hydrological, chemical and morphological characteristics of the un-impacted marine region. • Decreasing trend of nutrients concentrations in water column of human impacted areas, statistically defined. • Reduction of BOD emissions from land-based sources. • Reduction of nutrients emissions from land-based sources **CI 14** • Chlorophyll a concentration in high-risk areas below thresholds • Decreasing trend in chl-a concentrations in high risk areas affected
GES Operational Objective (UNEP/MED WG473/7) (2019)	**CI 13** Human introduction of nutrients in the marine environment is not conducive to eutrophication **CI 14** Direct and indirect effects of nutrient over-enrichment are prevented

4.2.1. The IMAP Environmental Assessment of the Aegean and Levantine Seas (AEL)

224. At the stage of the present document finalization for consideration of the Meeting of CorMon on Pollution Monitoring, the assessment findings for the Alboran Sea, as the Sub-division of the WMS, and the Levantine Sea, as the Sub-division of the AEL, were finalized. The preparation of the remaining assessments at the level of the Subdivisions in the AEL, WMS, and CEN is foreseen within the finalization of the IMAP Pollution Cluster thematic assessments by applying the Simplified methodology based on G/M comparison.

Available data.

225. A detailed data analysis was performed in order to decide on applying the assessment methodologies that can be found optimal for specific sub-region/sub-division in the present circumstances related to the lack of data reporting. Table 4.2.1.1 informs on data availability in AEL by considering data reported by the Contracting Parties by 31st October, the cut-off date for data reporting. Figure 1 shows the locations of sampling stations in the AEL Sub-region.

Table 4.2.1.1. Data availability by country and year for the Aegean Levantine Sea (AEL) Sub-region showing data reported by the CPs for the assessment of EO5 (CI13 and CI14) up to 31st Oct 2022.

Country	Year	Amon	Ntri	Ntra	Phos	Tphs	Slca	Cphl	Temp	Psal	Doxy
Cyprus	2016	182	172	197	89	-	17	180	205	203	186
	2017	38	15	48	14	-	28	141	150	150	131
	2018	39	27	41	41	-	36	56	93	91	109
	2019	45	22	49	49	-	49	37	38	38	62
	2020	84	67	82	82	-	39	86	72	71	72
	2021	-	-	-	-	-	-	136	112	112	107
Greece	2016-2021	No data provided									
Egypt	2016-2021	No data provided									
Israel	2017	15	15	15	15	-	15	15	15	15	15
	2018	14	14	14	14	-	14	14	13	13	13
	2019	14	14	14	14	-	14	14	14	14	14
	2020	14	14	14	14	-	14	14	14	14	14
Lebanon	2017	-	225	225	225	-	-	195	224	224	-
	2018	-	286	286	286	-	-	247	285	285	-
	2019	-	547	547	547	-	40	386	538	538	-
	2020	-	268	268	268	-	-	160	268	268	-
	2021	-	291	291	291	-	-	154	291	291	-
Syria	2016-2021	No data provided									
Turkey	2016	342	209	341	342	341	342	209	342	342	307
	2019	1460	1055	1479	1138	1545	972	1052	994	17713	1558

Amon - Ammonium; Ntri- Nitrite; Ntra – Nitrate; Phos – Orthophosphate; Tphs—Total phosphorous; Slca – Orthosilicate; Cphl – Chlorophyll *a*; Temp – Temperature; Psal – Salinity; Doxy – Dissolved Oxygen.

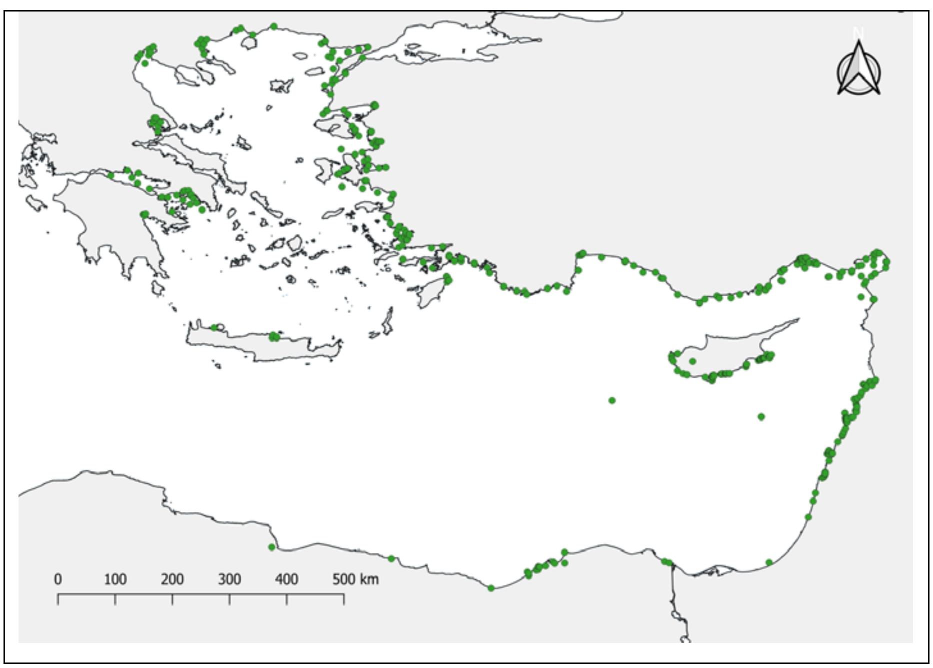


Figure 4.2.1.1. The locations of sampling stations in the AEL Sub-region

226. From Table 4.2.1.1 it can be found that the CPs in the southern Mediterranean rim did not report valid data as required by Decision IG.23/6 of COP 20 related to the 2017 Mediterranean Quality Status Report (MED QSR), and Decision IG.24/4 of COP21 providing the 2023 MED QSR Roadmap implementation.

227. Cyprus provided data for the period 2016-2021 and data for a variable number of stations were provided for different years. From the first screening only data for 10 to 15 stations can be used. Frequency ranged from 2 to 6 times per year and most of the IMAP mandatory parameters were measured. An additional quality check of data is needed in order to understand if a reliable assessment can be performed.

228. Israel provided data only for one sampling per year (summer) for the period 2017-2020. It is not in line with the IMAP requirement, which for example in the best case of oligotrophic waters requires bimonthly frequency in the Coastal Waters (CW) and seasonal frequency in the Offshore Waters (OW).

229. Lebanon provided data for the period 2017-2021, but only data for 2019 are compatible with the IMAP requirements. Other reported data are related to monitoring of beaches, therefore, where local processes (waves, resuspension, etc.,) substantially influence the measurements. For that reason, data cannot be used for IMAP EO 5 assessment.

230. Turkey provided only data for 2019 which need additional quality check given several stations are located in transitional waters which are heavily impacted from the land and subject to great variability. Although data for 2016 should not be considered for the preparation of the 2023 MED QSR, they were analysed given the present scarcity of data reported. However, these data were generated in the course of only one cruise, and therefore they cannot be used for the present IMAP EO 5 assessment.

231. Some of data were reported to IMAP IS very close to the 31st October, the cut-off date for data reporting, and without having a functional data quality control at the level of IMAP IS, at this late stage it was impossible to undertake data quality control and evaluation including through direct consultations with the CPs.

a) <u>The Levantine Sea (LEVS) Sub-division</u>

<u>*Available data.*</u>

232. Given the above explained status of data reported, in particular the lack of homogenous and quality assured data reported in line with IMAP requirements, it was necessary to explore the use of alternative data sources. The COPERNICUS source was found relevant regarding the existence of a systematic repository of remote sensing data for Chl *a*. Using only Chl *a* data, with a good geographical coverage (1 x 1 km) and high sensing frequency (daily), it is possible to tentatively develop a simple assessment method, by applying ecological rules and a comparison of the obtained values to the defined G/M threshold. Due to a huge amount of data for the whole AEL which was impossible to process with an ordinary PC, at the stage of closing preparation of the 2023 MED QSR IMAP Pollution Chapters it was possible to perform only the assessment for the Levantine Sea, one of the two subdivisions of AEL.

233. Chlorophyll *a* data for the Levantine Sea Sub-division, comprise of **22 million records,** were downloaded from the Copernicus web-site[20]. Data elaboration was performed by using R, an open-source

[20] https://data.marine.copernicus.eu/product/OCEANCOLOUR_MED_BGC_L4_NRT_009_142/description

language widely used for statistical analysis and graphical presentation (R Development Core Team, 2022)[21]. Maps are elaborated using QGIS 3.28, an open-source GIS tool (UNEP/MAP MED POL 2023).

234. For every point of the grid (Figure 4.2.1.2), a GM annual value was calculated, as required in the COMMISSION DECISION (EU) 2018/229[22]. The parameter values were expressed in µg/l of Chlorophyll a, for the geometric mean (GM) calculated over the year in at least a five-year period. These GM annual values were later used as a metric for the development of the assessment criteria for the present CI 14 assessment.

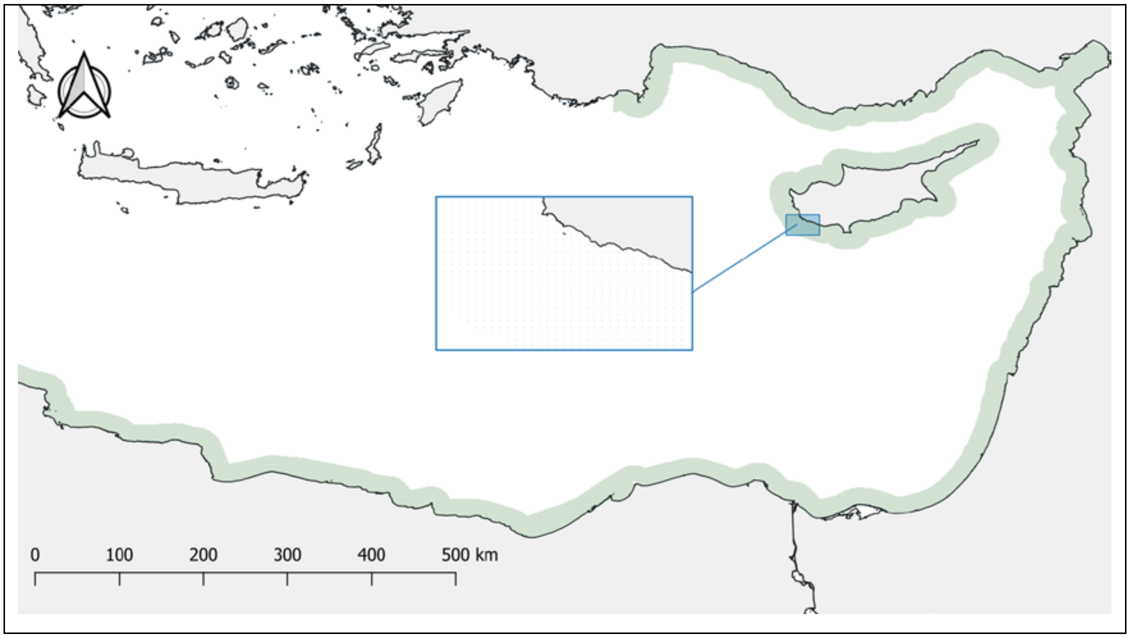


Figure 4.2.1.2. The Levantine Sea Sub-region: The dots in the assessment zones represent the data in the grid (1 x 1 km). In the small rectangle a detailed view of the sensing grid is presented.

Setting the areas of assessment.

235. In the absence of areas of monitoring declared by the CPs, and by following the rationale of the IMAP national monitoring programmes related to distribution of the monitoring stations, as well as the rules for integration and aggregation of the assessment products as elaborated in UNEP/MED WG.492/13/Rev.2, the two zones of assessment were defined in the Levantine Sea Sub-division for the purposes of the present work: i) the coastal zone and ii) the offshore zone.

236. For purpose of the present work, it should also be recalled that GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase) were also used for all countries in the area.

[21] R Development Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0. http://www.R-project.org

[22] Commission Decision (EU) 2018/229 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

237. The principle of the NEAT IMAP GES assessment methodology applied in the Adriatic Sea Sub-region, as well as in the Western Mediterranean Sea Sub-region regarding CI 17, for setting of the spatial assessment units (SAUs) within the two main assessment zones along the IMAP nesting scheme, was also followed for setting the coastal (CW) and the offshore monitoring zones (OW) in the Levantine Sea Sub-division. The CW included internal waters and one Nautical Mile outward. The offshore waters start at the outward border of CW and extend to 20 km outward given this coverage corresponds to the area where national monitoring programmes are performed as shown in Figure 4.2.1.1.

238. The AZ were divided between the five areas Northern, Eastern, Cyprus Island and the two Southern (West and East), which delimitations are shown on Figure 4.2.1.3. (upper map). It resulted in eight SAUs (i.e., CWNO – Northern CW; OWNO – Northern OW; CWEA – Eastern CW; OWEA – Eastern OW; Cyprus Island CW – CWCI; Cyprus Island OW – OWCI; Southern East CW – CWSE; Southern East OW – OWSE; Southern West CW – CWSW; and Southern West OW – OWSW). The finest IMAP SAUs were further set on the base of nested assessment areas (AZs, five areas) by considering the national areas of monitoring and hydrographic characteristics.

239. The finest IMAP SAUs set in the Levantine Sea Sub-division for the purpose of the present CI 14 assessment are shown in Table 4.2.1.2. Figure 4.2.1.3 (lower map) depicts the finest IMAP SAUs nesting in the two main assessment zones i.e. CW and OW of the Levantine Sea Sub-division.

Table 4.2.1.2. The finest IMAP spatial assessment units (SAUs)

AZ	SAU	SAUs
CW	CI	CWCICYP
CW	EA	CWEAISR
CW	EA	CWEALBN
CW	EA	CWEAPSE
CW	EA	CWEASYR
CW	NO	CWNOTUR
CW	SE	CWSEEGY
CW	SW	CWSWEGY
CW	SW	CWSWLBY
OW	CI	OWCICYP
OW	EA	OWEAISR
OW	EA	OWEALBN
OW	EA	OWEAPSE
OW	EA	OWEASYR
OW	NO	OWNOTUR
OW	SE	OWSEEGY
OW	SW	OWSWEGY
OW	SW	OWSWLBY

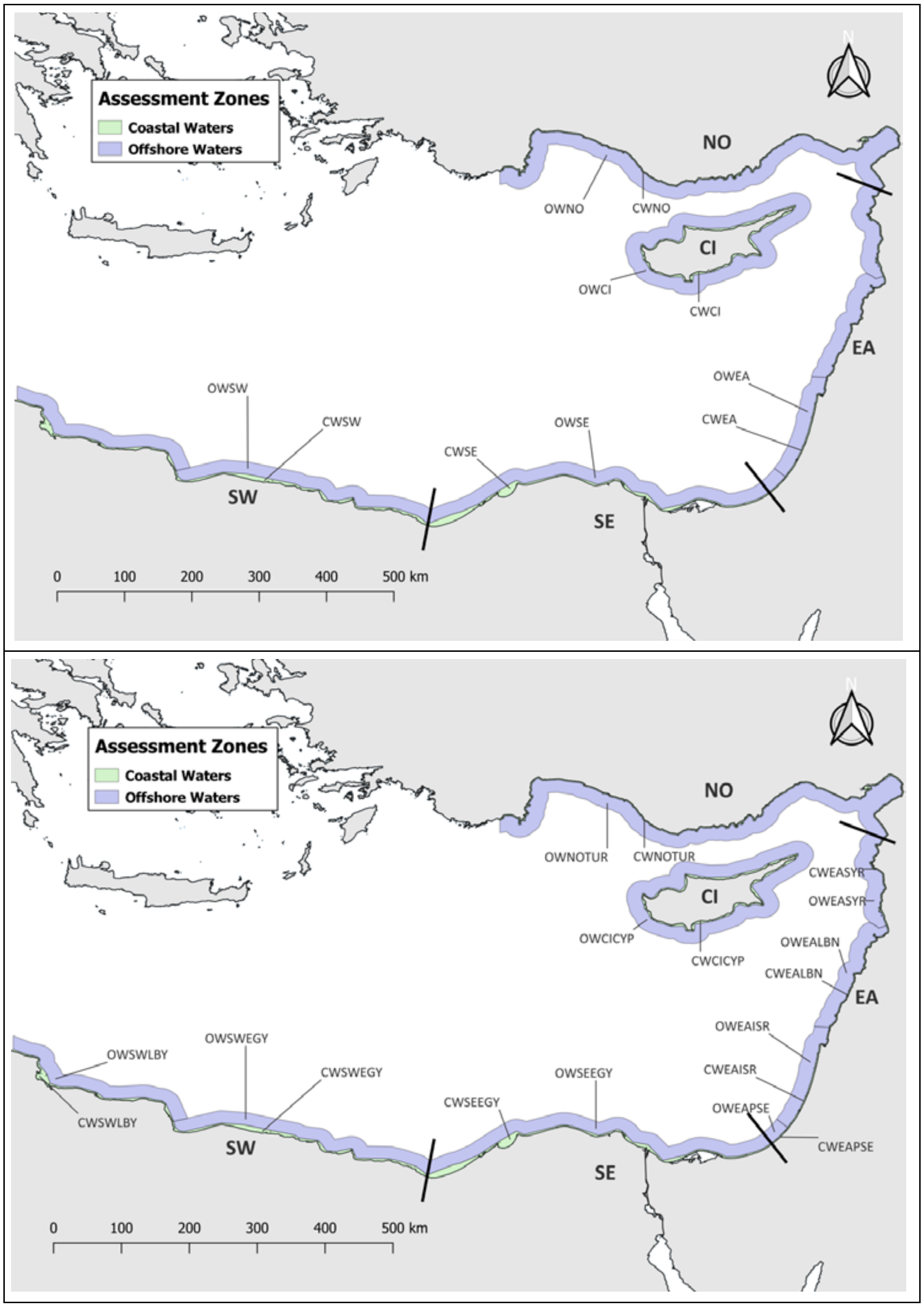


Figure 4.2.1.3. The nesting of the highest level of IMAP SAUs set in the coastal (CW) and the offshore assessment (OW) zones for the Levantine Sea Sub-division by SAU (upper map); and depiction of the finest IMAP SAUs (lover map).

<u>Setting the GES/non-GES boundary value/threshold for the Simplified G/M comparison assessment methodology application in the LEVS</u>

240. The definition of baseline and threshold values for IMAP CIs 13 and 14 in the Mediterranean Sea is an ongoing process (UNEP/MAP -MED POL, 2022) . The setting of GES-nonGES boundary limits

within GES assessment of the Adriatic Sea Sub-region for IMAP CIs 13 and 14 were based on the boundary and reference values defined for TP and DIN, and updated ones for Chl *a*, as approved in UNEP/MED WG.533/4 by the Meeting of CorMon on Pollution Monitoring (17 and 30 May 2022).

241. Within the present work, attributes were added to all new satellite derived Chl*a* data points in order to allow their use for calculation of the assessment criteria by the CW and OW, and SAUs in the Levantine Sea Sub-division.

242. Namely, the use of a new parameter for assessment i.e. satellite derived Chl*a* imposes calculation of a new set of assessment criteria given absence of any tested relationship of the satellite derived Chl*a* data with *in situ* measured Chl*a* data based on effects-pressures relationship. Namely, the use of reference and boundary water types related values, as set by the Decision IG.23/6 of COP 20 (MED QSR), was impossible for the present work.

243. In order to calculate the assessment criteria applicable within the present work, the annual GM values for satellite derived Chl*a* data were normalized using the R package *bestNormalize*. Then, the normalization process was tested for usual normalisation transformation, log x, boxcox, yeojohnson and Ordered Quantile normalizing transformation (orderNorm). The best normalisation was obtained with *orderNorm()*, and it was used for calculation of the assessment criteria applied to deliver the present CI 14 assessment (UNEP/MAP MED POL, 2023) .

244. The normalization of data is important as it allows generation of the comparable datasets for different assessment zones within the specific Sub-region/Sub-division, and then at upper level between different Sub-regions/subdivision. Further to comparable datasets, it ensures calculation of all aspects relevant to data distribution i.e., z-scores, percentiles, means, etc.

245. For the assessment of CI 14, the Reference conditions (RC) were calculated from the normalized values and were represented by the 10th percentile. For setting the G/M threshold, a modification of the rule applied in the Baltic Sea (Andersen et al. 2011[23]; HELCOM 2010[24]) was applied within the present work in the Alboran Sea Sub-division given the 50th percentile represents the mean value of the distribution, and the 85th percentile ~ mean +1 SD represents the G/M threshold. It was necessary to use this criterion given expert - based analysis of the satellite derived Chl*a* preliminary indicates that most of the assessed waters are in the high status (UNEP/MAP – MED POL, 2023).

246. The transformation of percentile to z-scores were obtained using the *pnorm()* an *qnorm()* functions in R. The RC values (oN10) and the G/M thresholds (oN85) were calculated from the normalized values through the *predict* function. The results of calculation are presented in Table 4.2.1.3. and are obtained by the AZs and SAUs set in the Levantine Sea Sub-division.

Table 4.2.1.3: Reference conditions (oN10) and G/M threshold (oN85) set by IMAP Assessment zones (AZ) and Spatial Assessment Units (SAU) in the Levantine Sea Sub-division.

AZ	SAU	oN50	oN50+50	oN90	oN10	oN85	oN25
CW	CI	0,047	0,071	0,075	0,034	0,065	0,039
CW	EA	0,462	0,692	1,762	0,125	1,402	0,209
CW	NO	0,152	0,227	2,156	0,066	1,454	0,089
CW	SE	1,769	2,653	5,675	0,059	4,773	0,174

[23] Andersen, J. H., Axe, P., Backer, H., Carstensen, J., Claussen, U., Fleming-Lehtinen, V., et al. (2011). Getting the measure of eutrophication in the Baltic Sea: towards improved assessment principles and methods. Biogeochemistry, 106(2), 137–156.
[24] HELCOM. (2010). Ecosystem health of the Baltic Sea 2003-2007: HELCOM Initial Holistic Assessment.

AZ	SAU	oN50	oN50+50	oN90	oN10	oN85	oN25
CW	SW	0,038	0,056	0,161	0,025	0,104	0,029
OW	CI	0,039	0,059	0,051	0,029	0,049	0,034
OW	EA	0,061	0,092	0,142	0,042	0,110	0,051
OW	NO	0,064	0,095	0,170	0,044	0,140	0,052
OW	SE	0,227	0,341	1,495	0,042	0,990	0,093
OW	SW	0,031	0,047	0,037	0,023	0,035	0,028
oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile, oN25 – 25th percentile							

247. It must be noted that by selecting the 85th percentile of the normalized distribution as G/M boundary limit, therefore as the limit between the acceptable and the unacceptable statuses i.e. GES and non GES in the Levantine and Alboran Sea Sub-divisions, the compatibility of the present classification was achieved with a five classes GES/non GES scale set in the Adriatic Sea Sub-region, as explained above in Section 2.

Results of the Simplified G/M comparison assessment methodology application in the ALBS.

248. Upon setting the reference conditions and the G/M threshold, each observation point, or area were classified in GES or non-GES, by comparing the value of the indicator i.e., the satellite derived Chl*a* to the G/M threshold, i.e. the back transformed 85th percentile of normalized distribution.

249. The results of CI 14 assessment using the satellite derived Chl*a* data are presented in Tables 4.2.1.4. and 4.2.1.5, and Figure LEVS 5.1.1.E. The likely GES (Table 2.5.2.b.) corresponds to the RC conditions, as well as to the values below the 85th percentile of normalized distribution set as GES/non GES boundary (i.e. blue coloured cells in the last column of Table 4.2.1.4 and 4.2.1.5). The likely non GES corresponds to the class above G/M boundary limit (i.e. red coloured cell in the last column of Tables 4.2.1.5).

250. The assessment results show that all evaluated assessment zones can be considered likely in GES regarding assessment of the satellite derived Chl*a* data. Further to this likely GES assigned to the assessment zones, it can be preliminary found that only 1 out of 18 SAUs is likely in non GES. However, it must be noted that the present SAUs are set at an insufficient level of fineness for a reliable assessment (Table 4.2.1.4 and Figure LEVS 5.1.1.E). This likely non GES SAU is located in the OW in the southern part of the Eastern Levantine Sea. The local sources of pollution are probably the main driver contributing to the weakened status of the SAU.

251. An additional assessment was tentatively performed by applying the Simplified G/M methodology for every satellite derived Chl*a* point of the data grid (Figure LEVS 5.1.1.2). Due to the high geographical variability of the biogeochemical processes at such scale (1 x 1 km), this additional assessment is also only indicative. The points in the grid with the concentrations of the satellite derived Chl*a* data lower than the RC values were also plotted.

252. This additional analysis supports identification of the main biogeochemical controlling processes in the Levantine Sea sub-division. The main impacted area is located in the water in front of Mersin and in the Iskenderun Bay. A slight impact can also be identified along the coast of Israel and in the OW in the southern part of the Eastern Levantine Sea, as well as in front of Port Said and Alexandria. The influence of the Nile River through the river Delta is weak and confirms the changes in the area caused by construction of the Aswan dam. A coastal impact is also observed in the Tobruk area in the waters of Libya.

253. A coupling of the preliminary results obtained by the application of the Simplified G/M assessment at the level of SAUs, and its additional application on every satellite derived Chl*a* point of the observation grid (1 x 1 km), leads to the conclusion that the present assessment findings can only be used as an indication of the environmental status in the LEVS. The lack of homogenous and quality-assured data reported in line with IMAP requirements, and the SAUs presently set on a large scale, greatly limit the reliability of the assessment. For reliable assessment of eutrophication processes, the finest SAUs must be set by using the finest delineation of water bodies and related distribution of the water typology.

254. The additional assessment results show the potential of using the satellite derived Chl*a* data for GES assessment. This encourages future decision-making regarding inclusion of an additional sub-indicator within the monitoring of CI 14. Namely, coupling of satellite derived Chl *a* data with Chl *a* concentrations *in situ* measured would greatly enhance the IMAP monitoring.

Table 4.2.1.4. Results of the assessment (G_nG.oN85 - the GES class corresponding to all values below the 85th percentile set as GES/non GES boundary limit) of the Levantine Sea Sub-division by Assessment Zones (AZ) and Spatial Assessment Units (SAUs). Blu coloured SAUs indicates likely in GES, Red coloured SAUs indicate likely in non GES.

AZ	SAU	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_nG.oN85
CW	CI	677	0,050	0,047	0,071	0,034	0,065	G
CW	EA	257	0,458	0,462	0,692	0,125	1,402	G
CW	NO	163	0,199	0,152	0,227	0,066	1,454	G
CW	SE	853	1,111	1,769	2,653	0,059	4,773	G
CW	SW	1281	0,050	0,038	0,056	0,025	0,104	G
OW	CI	10383	0,040	0,039	0,059	0,029	0,049	G
OW	EA	9178	0,074	0,061	0,092	0,042	0,110	G
OW	NO	12598	0,083	0,064	0,095	0,044	0,140	G
OW	SE	7568	0,331	0,227	0,341	0,042	0,990	G
OW	SW	10458	0,032	0,031	0,047	0,023	0,035	G
CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions)								

Table 4.2.1.5. Result of the assessment (G_nG.oN85- the GES class corresponding to all values below the 85th percentile set as GES/non GES boundary limit) of the Levantine Sea Sub-division for the finest Spatial Assessment Units (SAUs). Blu coloured SAUs indicate likely in GES, Red coloured status indicate – likely in non-GES.

AZ	SAU	SAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_N.G.oN85
CW	CI	CWCICYP	677	0,050	0,071	0,034	0,065	G
CW	EA	CWEAISR	95	0,498	0,692	0,125	1,402	G
CW	EA	CWEALBN	91	0,360	0,692	0,125	1,402	G
CW	EA	CWEAPSE	26	1,362	0,692	0,125	1,402	G
CW	EA	CWEASYR	45	0,331	0,692	0,125	1,402	G
CW	NO	CWNOTUR	163	0,199	0,227	0,066	1,454	G
CW	SE	CWSEEGY	853	1,111	2,653	0,059	4,773	G
CW	SW	CWSWEGY	725	0,035	0,056	0,025	0,104	G
CW	SW	CWSWLBY	556	0,080	0,056	0,025	0,104	G
OW	CI	OWCICYP	10383	0,040	0,059	0,029	0,049	G
OW	EA	OWEAISR	2724	0,086	0,092	0,042	0,11	G

AZ	SAU	SAUs	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_N.G.oN85
OW	EA	OWEALBN	3243	0,067	0,092	0,042	0,11	**G**
OW	EA	OWEAPSE	486	0,158	0,092	0,042	0,11	**NG**
OW	EA	OWEASYR	2725	0,062	0,092	0,042	0,11	**G**
OW	NO	OWNOTUR	12598	0,083	0,095	0,044	0,14	**G**
OW	SE	OWSEEGY	7568	0,331	0,341	0,042	0,99	**G**
OW	SW	OWSWEGY	5843	0,030	0,047	0,023	0,035	**G**
OW	SW	OWSWLBY	4615	0,033	0,047	0,023	0,035	**G**

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5 year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions);

4.2.2. The IMAP GES Assessment of the Adriatic Sea Sub-region (ADR)

255. The GES assessment of EO 5 is provided at IMAP CIs 13 and14 level per TP, DIN and Chl a, as mandatory parameters measured within monitoring of these two indicators. Other parameters were not considered given lack of data reported by the CPs. The results of aggregation and integration within the nested scheme are provided at i) the IMAP national SAUs & subSAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of SubDivisions (NAS-1, NAS-12, CAS-1, CAS-12, SAS-1, SAS-12); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (the Adriatic Sea). Given Albania, Bosnia and Herzegovina, and Greece faced the lack of data for CIs 13 and 14, they were not considered in the GES assessment for IMAP EO5(UNEP/MAP – MED POL, 2023).

Available data.

256. The data reported to the IMAP Pilot Info System by the Contracting Parties bordering the Adriatic Sea i.e. Croatia, Italy, Montenegro, and Slovenia for the period 2015-2020 were used for the sub-regional assessment for Chl a, TP and DIN, within present NEAT GES assessment for IMAP CIs 13 and14. Data reported by Albania, Bosnia and Herzegovina and Greece were missing or were insufficient or not reported in line with mandatory data standards.

257. The data elaboration was done only for the surface layer as the main layer of eutrophication impact. Namely, freshwaters are the main pressure driver and mostly contribute to the stratification of the water column, therefore they confine the newly fetched nutrients mainly to the surface layer.

Table 4.2.2.1: Temporal coverage of the monitoring data collected for the Adriatic Sea shown against the finest areas of assessment (IMAP subSAUs). The years of data collected per SAU are shown.

Sub-division	**Zone**	**SAU**	**Years monitored**
North Adriatic (NAS)			
	NAS coastal/intercoastal		
		MAD-HR-MRU-3	2016-2019
		IT-NAS-1	2015-2020
		MAD_SI_MRU_11	2015-2020
	NAS offshore		
		HR-NAS-12	2016-2019
		IT-NAS-12	2015-2020
		MAD_SI_MRU_12	2015-2020
Central Adriatic (CAS)			
	CAS coastal/intercoastal		
		MAD-HR-MRU-2	2016-2019
		IT-CAS-1	2015-2020
	CAS offshore		
		HR-CAS-12	2016-2019

Sub-division	**Zone**	**SAU**	**Years monitored**
		IT-CAS-12	2015-2020
South Adriatic (SAS)			
	SAS coastal/intercoastal		
		MAD-HR-MRU_2	2016-2019
		IT-SAS-1	2015-2020
		MNE-1	
		AL-1	-
	SAS offshore		
		HR-CAS-12	-
		IT-SAS-12	2015-2020
		MNE-12	
		AL-12	-
		MAD-EL-MS-AD	-

258. For the application of the NEAT software, data were grouped per parameters, ecosystem and SAUs in all the Adriatic sub-divisions (NAS, CAS, SAS). Average concentrations (geometric means) and respective geometric standard deviation, and standard error of geometric means were then calculated in the respective groups as presented here-below.

259. **The geometric mean (*GM*)** is defined as the nth root of the product of n numbers, i.e., for a set of numbers x_1, x_2, ..., x_n, the geometric mean is defined as

$$GM[x] = \left(\prod x_i\right)^{\frac{1}{n}} \quad (1)$$

or, equivalently, as the arithmetic mean (*AM*) in logscale:

$$GM[x] = e^{AM[\log x]} \quad (2)$$

260. **The geometric standard deviation (GSD) is calculated as the regular statistic on the log data, $SD[log x]$ then rescaled back:**

$$GSD[x] = e^{SD[\log x]} \quad (3)$$

261. **The standard error of geometric mean (SEGM): Since the through mean of the population (μ_G) is not normally known the sample mean $GM[x]$ is used, but then, like with the regular standard deviation and error formulas N−1 instead of N is used:**

$$SEGM[x, N] = \frac{GM[x]}{\sqrt{N-1}} SD[\log x]$$

262. A difference between EO9/CI 17 and EO5/CIS 13&14 must be noted. For the NEAT assessment different metrics were used. For EO9 as a measure of central tendency, the arithmetic mean and standard error were used, on opposite to the use of geometric mean and the standard error of geometric mean for EO5. It was necessary given the assessment criteria for EO5 were developed by applying the later metrics.

The integration of the areas of assessment and assessment results by applying the 4 levels nesting approach.

263. For setting the IMAP areas of assessment for IMAP CIs 13 and 14, the 4 levels nesting approach was followed as elaborated for IMAP CI 17 (UNEP/ MAP – MED POL, 2022, amended for the purpose of CIs 13 and 14) and presented here-below in section 4.2.2.2. However, the finest areas of assessment set for CI 17 were further adjusted to serve the purpose of EO5 assessment. One additional GIS layer was created within 3rd step of nesting scheme. This layer shows a distribution of the water classes within the coastal and offshore zones. It was overlaid on the IMAP sub-SAUs defined for IMAP CI 17, which resulted in an adjustment of the finest areas of assessment for IMAP CIs 13 and 14. In that regard, distribution of the finest areas of assessment is mainly related to the scientific knowledge which takes into account the specifics of the monitoring and assessment of national waters. Where it was possible, the distribution of water types existing in the Adriatic Sea Sub-region (I, IIA and IIIW) also guided the adjustment of the finest areas of assessment for IMAP EO5. Namely, the three types of water are mainly discriminated by freshwater content which on the other side is correlated with the pressures from land. This leaded to a separate aggregation of the assessment results per water types in order to get the status of CIs 13 and 14 in different water types for all SAUs. Accordingly, details on setting the finest areas of assessment for IMAP EO 5 were provided per countries.

264. After setting the finest IMAP areas of assessment, their nesting within three sub-divisions of the Adriatic Sea sub-region was undertaken in the same manner applied for IMAP CI 17. The approach followed for the nesting of the areas is 4 levels nesting scheme (1 - being the finest level, 4 - the highest):

- 1st level provided nesting of all national IMAP SAUs and subSAUs within the two key IMAP assessment zones per country i.e. coastal and offshore zone;
- 2nd level provided nesting of the assessment areas set in IMAP assessment zones i.e. the coastal and offshore zones, on the subdivision level i.e. i) NAS coastal (NAS-1), NAS offshore (NAS-12); ii) CAS coastal (CAS-1), CAS offshore (CAS-12); iii) SAS coastal (SAS-1), SAS offshore (SAS-12);
- 3rd level provided nesting of the areas of assessment within the 3 subdivisions (NAS, CAS, SAS);
- 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub Region.

This nesting scheme is shown schematically in Figure **4.2.2.1.**

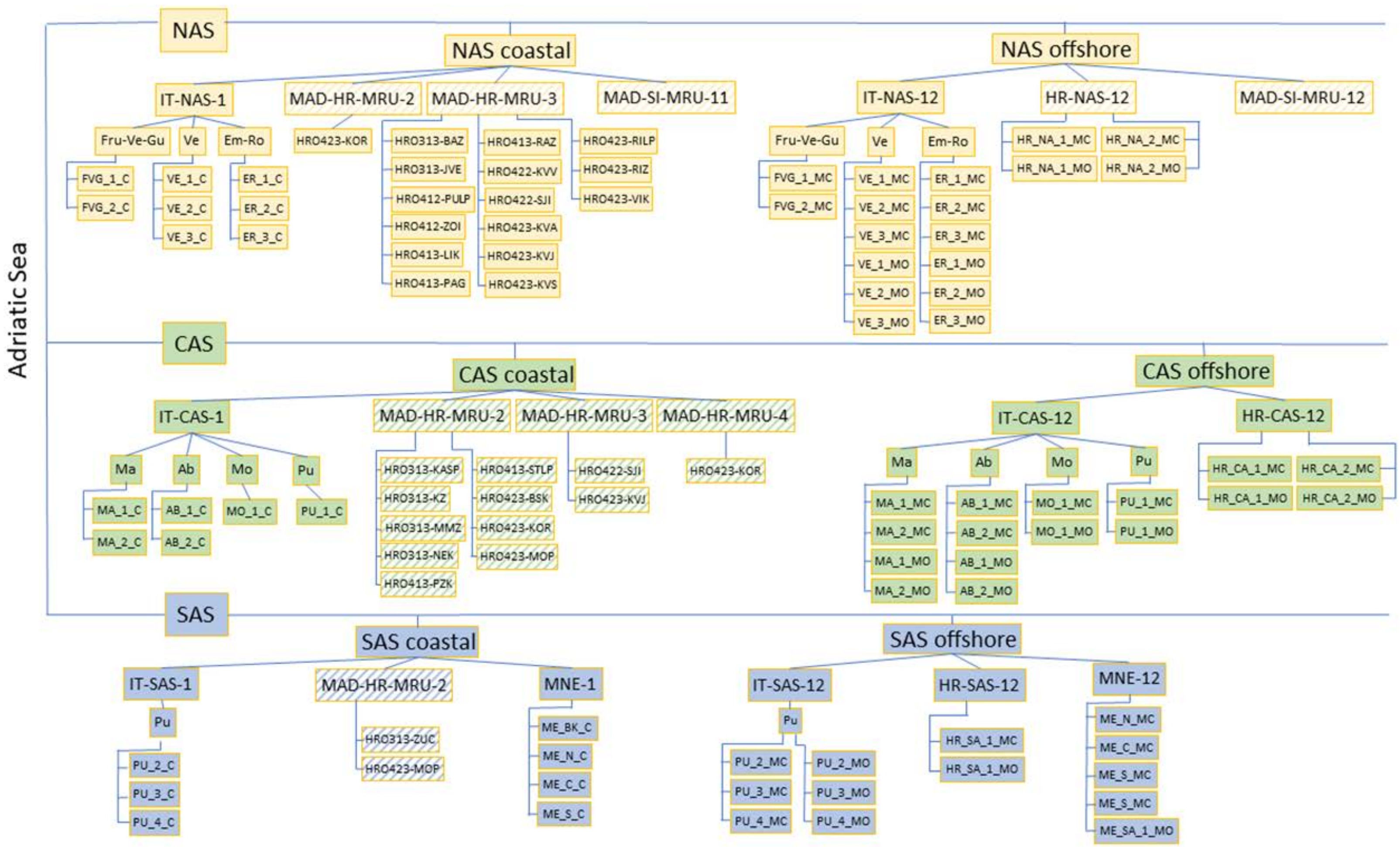


Figure 4.2.2.1: The nesting scheme of the SAUs defined for the Adriatic Sea based on the available information. Shaded boxes correspond to official MRUs declared by the countries that are EU MSs and that were decided to be used as IMAP SAUs.

265. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, the scope of all Adriatic SAUs and subSAUs were defined. All of them were introduced in the NEAT tool along with their respective codes and surface of the areas (km^2).

266. Within each SAU under ‘habitats’ the water types are introduced. Under ‘ecosystem component’ the 3 measured parameters i.e. DIN, TP and Chl *a* are assigned.

267. For each SAU and ‘Ecological Component’ and ‘Habitat’ (Water type), geometric mean and standard error of the geometric mean per parameter are inserted.

268. Boundary limits and class threshold values per SAU per parameter and per matrix (i.e. NEAT habitat) are applied. The tool obligatory requires 2 limits which define the best and the worse conditions and one threshold discriminating between GES-nonGES status. A five classes assessment scale ‘High-Good-Moderate-Poor-Bad’ is then produced. The GES-nGES threshold discriminates between the Good-Moderate classes. Details on boundary limits and threshold values are given in Chapter 4 and in Tables 4 and 5.

<u>Setting the GES/non-GES boundary value/threshold for the IMAP NEAT GES Assessment in the ADR.</u>

269. The definition of baselines and threshold values for IMAP CIs 13 and 14 in the Mediterranean Sea is an ongoing process. The setting of GES-nonGES boundaries within NEAT GES assessment for IMAP CIs 13 and 14 are based on the boundary values defined for TP and DIN, and updated ones for chlorophyll a, in the Adriatic Sea, as approved by the Meeting of CorMon on Pollution Monitoring (17 and 30 May 2022) (UNEP/MAP – MED POL, 2022)

270. Following the methodology applied for setting GES-nonGES threshold for IMAP CI17 (UNEP/MAP - MED POL 2022; 2023), the NEAT GES assessment of IMAP CIs 13 and 14 in the Adritic Sea sub-region considers that the range of concentrations equal to or below the G/M values corresponds to the good environmental status i.e. in GES, and the range of concentrations above the G/M values corresponds to non-good environmental status i.e. non-GES. This principle was also used for application of the traffic light approach within the 2017 MED QSR.

271. The use of NEAT tool for IMAP GES status requires in total five status classes i.e. high, good, moderate, poor, bad, in order to optimally discriminate the status related to different classes. The NEAT application also requires the two boundary limit values for the best and worse conditions (these are not threshold values but minimum and maximum values that determine the scale of the GES assessment) and one threshold value for the GES – nonGES status. These are mandatory by the tool which then produces five status classes linearly, depending on the distance of the concentrations from the two boundary limit values and the GES-nonGES threshold.

272. For the present analysis, the two boundary limit values are: i) Reference Conditions (RC); and ii) for maximum concentration of nutrients and chlorophyll *a*, the value calculated from the relationship (equation) of DIN and TP (the parameters of CI 13) with a value of 8 that is supposed to be highest one for TRIX (as internal standard). For CI14 (Chla) the equation is related to the pressure variable in our case DIN and TP where possible. All the equations and boundary values by water type are given in Table 4.2.2.2.

273. In line with such defined the two boundary limits, the following five status classes are produced: i) the high status (H) referring to RC (best conditions) < good status; ii) the good status (G); iii) the moderate status (M); iv) the poor status (P); v) the bad status (B) referring to values > than poor state and < than the maximum concentration. The five classes are divided by the boundary between them as follows: H/G; G/M (also the GES-nonGES threshold); M/P; and P/B.

Table 4.2.2.2: Boundary limits of the NEAT GES Cis 13 & 14 assessment scale and threshold values between five status classes.

Type	Equation	RC	H/G	G/M	M/P	P/B	Worst
Coastal							
I	**[TRIX]**		4.25	**5.25**	6.25	7	8
	[TP] = exp [(TRIX – 6.064)/1.349]	0.19	0.26	**0.55**	1.15	2.00	4.20
	[Chla] = 10.591 [TP]^1.237	1.4	2.01	**5.02**	12.56	24.99	62.5
IIA	**[TRIX]**	-	4	**5**	6	7	8
	[TP] = exp [(TRIX – 6.148)/1.583]	0.16	0.26	**0.48**	0.91	1.71	3.2
	[Chla] = 3.978 [TP]^1.347	0.33	0.64	**1.50**	3.51	8.21	19.2
IIIW	**[TRIX]**	2	3	**4**	5	6	7
	[TP] = exp [(TRIX – 6.148)/1.583]	0.07	0.14	**0.26**	0.48	0.91	1.7
	[Chla] = 3.978 [TP]^1.347	0.12	0.27	**0.64**	1.50	3.51	8.2
Offshore							
I	**[TRIX]**		4.25	**5.25**	6.25	7	8
	[DIN] = 10^[(TRIX – 3.08)/1.61]	0.15*; 0.29**	5.33	**22.28**	93.1	272	1 137
	[Chla] = 0.4295 [DIN]^0.64	0.21*; 0.66**	1.25	**3.13**	7.82	15.53	38.79
IIA	**[TRIX]**	-	4	**5**	6	7	8
	[TP] = exp [(TRIX – 6.148)/1.583]	0.16	0.26	**0.48**	0.91	1.71	3.22
	[Chla] = 3.978 [TP]^1.347	0.33	0.64	**1.50**	3.51	8.21	19.23
IIIW	**[TRIX]**	2	3	**4**	5	6	7
	[TP] = exp [(TRIX – 6.148)/1.583]	0.07	0.14	**0.26**	0.48	0.91	1.71
	[Chla] = 3.978 [TP]^1.347	0.12	0.27	**0.64**	1.50	3.51	8.21
*ME; **HR. IT							

274. The data (i.e. average values), as well as limits and threshold values are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and to facilitate aggregation on the CI or EO level.

275. Threshold concentrations are normalized in a 0 to 1 scale as follows:

$$0 \leq \text{bad} < 0.2 \leq \text{poor} < 0.4 \leq \text{moderate} < 0.6 \leq \text{good} < 0.8 \leq \text{high} \leq 1$$

276. The NEAT tool further aggregates data by calculating the average of normalized values of indicators (DIN, TP; Chla) on the SAU level (UNEP/MAP - MED POL 2022; 2023). This can be done either per each indicator per habitat separately or for all indicators i.e. parameters per habitats within the specific SAU. The first option leads to one value for each indicator separately for the specific SAU.

277. The process is then repeated for all nested SAUs (in a weighted or non- weighted mode). At the

end one NEAT value for the highest area of assessment is obtained (i.e. for the Adriatic Sea) either for all ecosystem components i.e, indicators/parameters assessed (TP, DIN – CI 13, chl a – CI 14) separately, or for all ecosystem components by habitat (water). In the weighted mode a weighting factor based on the surface area of each SAU is used.

278. The NEAT values are values between 0 to 1 and correspond to an overall assessment status per contaminant according to the 5-class scale.

279. The decision rule of GES/ non-GES is by comparison to the boundary class defined by the G/M threshold, and this is above/below Good (0.6).

Results of the IMAP NEAT GES Assessment of CIs 13 and 14 in the ADR.

280. Detailed assessment results for EO5 are provided per TP, DIN and Chl *a*, as mandatory parameters measured for CIs 13 and 14 level and also spatially integrated within the nested scheme at i) the IMAP national SAUs & sub-SAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of SubDivisions (NAS-1, NAS-12, CAS-1, CAS-12, SAS-1, SAS-12); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (Adriatic Sea) are presented in Table 4.2.2.3.

281. The Tabulated NEAT results as shown in Table 4.2.2.3. (schematic presentation, UNEP/MAP - MED POL 2023).

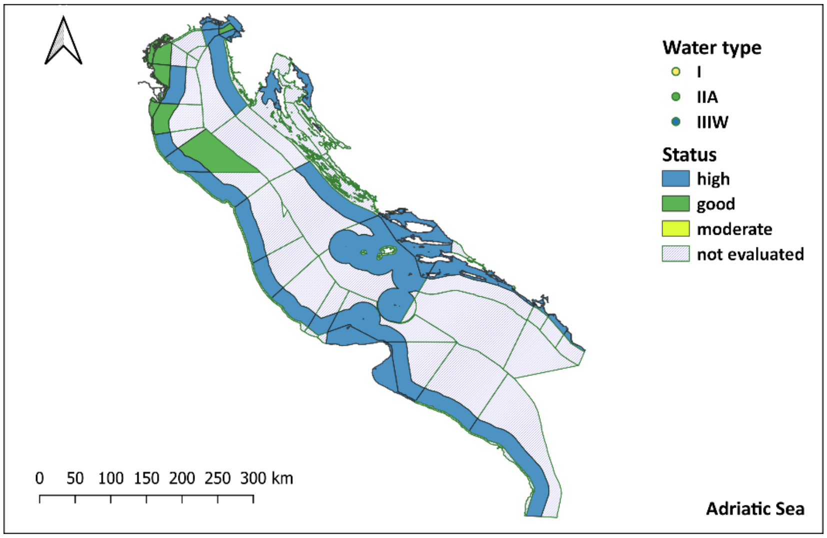
282. The aggregation of TP, DIN and Chl *a* was undertaken to obtain one status value (NEAT value) for all the levels of the nesting scheme. The aggregation of the assessment findings for these three parameters resulted in the NEAT value per specific SAUs. Then NEAT values per SAUs were spatially integrated to the sub-divisions and regional levels. The data matrix in Table 4.2.2.3 shows the results per indicator for all nesting levels. The integrated results for the sub-divisions (NAS, CAS, SAS) are shown in bold. The NEAT classes are marked per all three parameters to show the status.

283. Along with the aggregation of the parameters per SAUs, the NEAT tool has the possibility to provide assessment results by aggregating data per habitat in this case water types and then to provide their spatial integration within the nested scheme. This possibility was not used for the present assessment since the water types are more relevant in the coastal waters and less in the offshore waters. The final integrated result per SAUs (NEAT value) are expected to be the same irrespective of the two ways of aggregation of the assessment results (i.e. per indicator or per habitat).

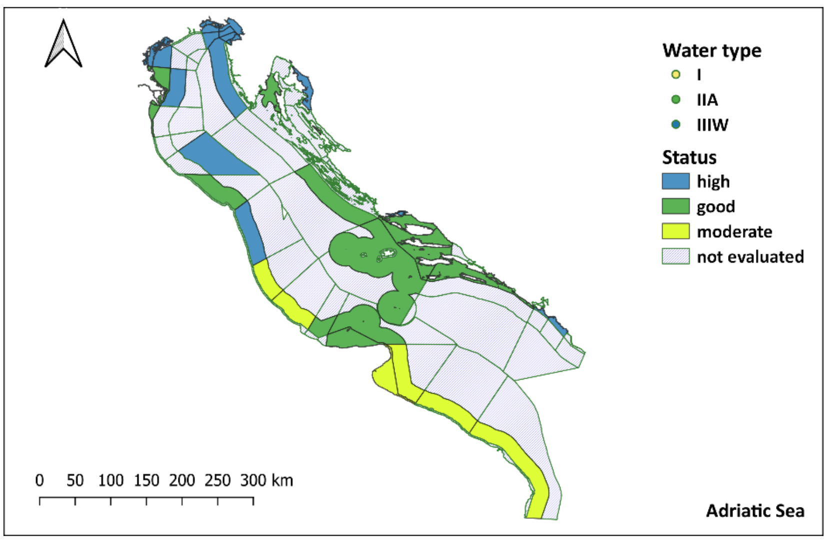
284. The detailed status assessment results show that all the SAUs achieve GES conditions (high, good status) that is indicated by the blue and green cells in Table 4.2.2.3. The GES status per assessment units and parameter is also shown on Figure 4.2.2.2. For all three parameters (CI 13 – DIN, TP and CI 14 – Chla), the results show that all SAUs and subSAUs are in GES. The only exception is the results for TP in a part of CAS and the SAS along the Italian coast, where a few subSAUs (AB_1_MC, AB_2_MC, PU_2_MC, PU_3_MC, PU_4_MC) are in moderate status. The assessment status for TP was possible for the whole Adriatic Sea given data availability at the level of subSAUs. The results of TP assessment indicate that probably an accumulation of phosphorus is present in the area. It is necessary to explore if the problem is related to nitrogen limitation of the area and subsequent accumulation of phosphorus, or a local source of pollution contribute to the generation of the pressure on marine environment. Non-GES status of a few subSAUs do not affect the overall assessment status and all SAUs fall under the GES status (high, good). The absence of some SAUs evaluation is related to the decision of the countries to monitor areas that are found relevant for the assessment of eutrophication and therefore excluding the areas where problems were not historically observed.

285. As already observed for IMAP CI17 (UNEP/MAP MED POL, 2022; 2023), , the present integrated assessment status results produced by applying the NEAT tool on the sub-division (NAS, CAS, SAS) and/or the Adriatic sub-Region level can only be considered as an example of how the tool works

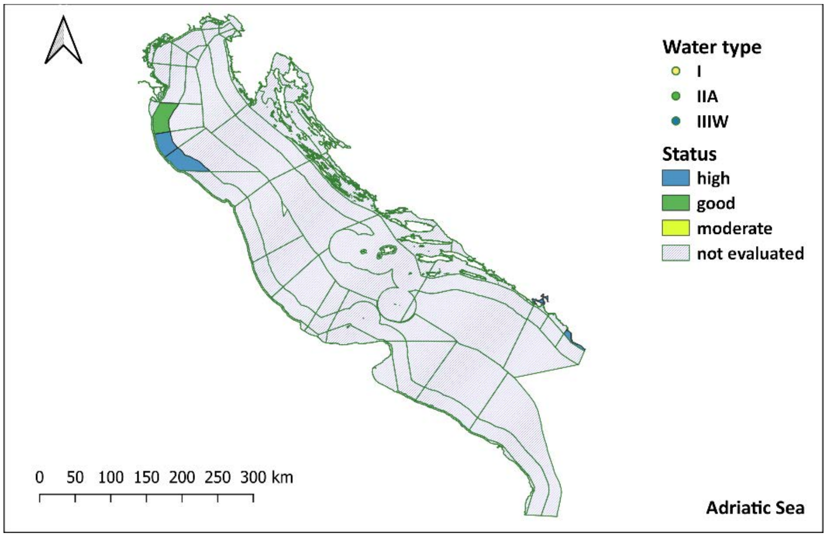
(4th and 3rd nesting levels). This is related to the fact that many SAUs lack data (blank cells in Table 4.2.2.3.). The lack of data can be related to the recognition that many CPs monitor an area of interest, therefore excluding the areas where problems were not historically observed. Anyway, the assessment per SAUs and integrated assessment on the two key nesting IMAP assessment zones i.e. coastal and offshore (NAS-1, NAS-12; CAS-1, CAS-12; SAS-1, SAS-12) (1st and 2nd nesting levels) can be considered more detailed for decision making.



Chl *a*



TP



DIN

Figure 4.2.2.2: The NEAT assessment results for IMAP CI13 (TP, DIN) and CI14 (Chl *a*), in the Adriatic Sea. Blank area corresponds to non-assessed subSAUs.

Table 4.2.2.3. Status assessment results of the NEAT tool applied on the Adriatic nesting scheme for the assessment of IMAP CIs 13 and 14. The various levels of spatial integration (nesting) are marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis described in 6.1.

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
Adriatic Sea	**128180**	**0**	**0.815**	**high**	**99.8**	**0.954**	**0.673**	**0.845**
Northern Adriatic Sea	**30865**	**0**	**0.888**	**high**	**100.0**	**0.892**	**0.890**	**0.84**
NAS-1	**9130**	**0**	**0.866**	**high**	**100.0**	**0.896**	**0.837**	
MAD-HR-MRU-3	6302	0	0.900	high	100.0	0.952	0.847	
HRO313-JVE	73	0						
HRO313-BAZ	4	0	0.787	good	56.9	0.760	0.814	
HRO412-PULP	7	0						
HRO412-ZOI	467	0						
HRO413-LIK	7	0						
HRO413-PAG	30	0.001	0.898	high	100.0	1.000	0.795	
HRO413-RAZ	10	0						
HRO422-KVV	494	0						
HRO422-SJI	1924	0						
HRO423-KVA	687	0.029	0.848	high	90.2	0.919	0.777	
HRO423-KVJ	1089	0						
HRO423-KVS	577	0						
HRO423-RILP	6	0						
HRO423-RIZ	475	0						
HRO423-VIK	455	0.019	0.979	high	100.0	1.000	0.958	
IT-NAS-1	2576	0	0.783	good	92.7	0.759	0.806	
IT-Em-Ro-1	372	0	0.682	good	99.6	0.757	0.608	
ER_1_C	254	0.003	0.682	good	99.6	0.757	0.608	
ER_2_C	64	0						
ER_3_C	54	0						
IT-Fr-Ve-Gi-1	560	0	0.958	high	100.0	0.917	1.000	
FVG_1_C	277	0.002	0.916	high	100.0	0.832	1.000	

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
FVG_2_C	283	0.002	1.000	high	100.0	1.000	1.000	
IT-Ve-1	1646	0	0.746	good	100.0	0.706	0.785	
VE_1_C	88	0						
VE_2_C	905	0.008	0.792	good	63.5	0.755	0.828	
VE_3_C	653	0.005	0.682	good	99.9	0.638	0.726	
MAD-Sl-MRU-11	85	0.001	0.923	high	100.0	0.903	0.942	
MAD-HR-MRU-2	166	0						
HRO423-KOR	166	0						
NAS-12	**21735**	**0**	**0.897**	**high**	**100.0**	**0.890**	**0.917**	**0.840**
IT-NAS-12	11141	0	0.832	high	98.8	0.777	0.898	0.840
IT-Em-Ro-12	7144	0	0.814	high	82.3	0.750	0.888	0.840
ER_1_MC	858	0.009	0.752	good	99.4	0.735		0.770
ER_2_MC	586	0.006	0.824	high	92.8	0.805		0.860
ER_3_MC	893	0.010	0.869	high	100.0			0.869
ER_3_MO	2888	0.031	0.814	high	67.9	0.739	0.888	
ER_2_MO	600	0						
ER_1_MO	1319	0						
IT-Fr-Ve-Gi-12	410	0	0.945	high	100.0	0.890	1.000	
FVG_1_MC	139	0.001	0.895	high	100.0	0.791	1.000	
FVG_2_MC	271	0.002	0.971	high	100.0	0.941	1.000	
IT-Ve-12	3588	0	0.854	high	95.9	0.811	0.898	
VE_1_MC	714	0						
VE_2_MC	467	0						
VE_3_MC	1041	0.028	0.854	high	95.9	0.811	0.898	
VE_1_MO	234	0						
VE_2_MO	190	0						
VE_3_MO	941	0						
MAD-Sl-MRU-12	129	0.001	0.935	high	100.0	0.870	1.000	
HR-NAS-12	10465	0	0.965	high	100.0	1.000	0.930	
HR_NA_1_MC	2057	0.082	0.965	high	100.0	1.000	0.930	

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
HR_NA_2_MC	2183	0						
HR_NA_1_MO	2566	0						
HR_NA_2_MO	3659	0						
Central Adriatic	**48802**	**0**	**0.832**	**high**	**100.0**	**0.984**	**0.680**	
CAS-1	**7582**	**0**	**0.853**	**high**	**100.0**	**0.995**	**0.712**	
MAD-HR-MRU-2	5240	0	0.870	high	100.0	0.994	0.747	
HRO313-NEK	253	0						
HRO313-KASP	44	0.001	0.783	good	66.7	0.750	0.816	
HRO313-KZ	34	0	0.938	high	100.0	0.991	0.886	
HRO313-MMZ	56	0						
HRO413-PZK	196	0						
HRO413-STLP	1	0						
HRO423-BSK	613	0.008	0.844	high	91.1	0.985	0.702	
HRO423-KOR	1564	0						
HRO423-MOP	2480	0.033	0.877	high	100.0	1.000	0.755	
IT-CAS-1	2091	0	0.811	high	66.6	1.000	0.623	
IT-Ab-1	282	0						
AB_1_C	103	0						
AB_2_C	179	0						
IT-Ma-1	320	0						
MA_1_C	172	0						
MA_2_C	148	0						
IT-Mo-1	229	0						
MO_1_C	229	0						
IT-Ap-1	1261	0	0.811	high	66.6	1.000	0.623	
PU_1_C	1261	0.017	0.811	high	66.6	1.000	0.623	
MAD-HR-MRU-4	184	0						
HRO422-VIS	184	0						
MAD-HR-MRU-3	67	0						
HRO422-SJI	14	0						

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
HRO423-KVJ	53	0						
CAS-12	**41219**	**0**	**0.828**	**high**	**100.0**	**0.981**	**0.674**	
HR-CAS-12	18797	0	0.845	high	100.0	1.000	0.691	
HR_CA_1_MC	2337	0.034	0.852	high	94.6	1.000	0.703	
HR_CA_2_MC	7745	0.113	0.843	high	100.0	1.000	0.687	
HR_CA_1_MO	5328	0						
HR_CA_2_MO	3388	0						
IT-CAS-12	22422	0	0.813	high	90.4	0.966	0.661	
IT-Ab-12	7526	0	0.719	good	100.0	1.000	0.438	
AB_1_MC	1056	0.027	0.705	good	100.0	1.000	0.411	
AB_2_MC	1250	0.032	0.731	good	100.0	1.000	0.461	
AB_1_MO	2480	0						
AB_2_MO	2741	0						
IT-Ap-12	5096	0	0.842	high	87.9	1.000	0.685	
PU_1_MC	2618	0.04	0.842	high	87.9	1.000	0.685	
PU_1_MO	2478	0						
IT-Ma-12	8097	0	0.871	high	100.0	0.907	0.835	
MA_1_MC	1480	0.03	0.822	high	90.0	0.870	0.775	
MA_2_MC	1629	0.033	0.915	high	100.0	0.941	0.890	
MA_1_MO	1391	0						
MA_2_MO	3597	0						
IT-Mo-12	1702	0	0.868	high	100.0	0.992	0.745	
MO_1_MC	654	0.013	0.868	high	100.0	0.992	0.745	
MO_1_MO	1048	0						
Southern Adriatic Sea	**48514**	**0**	**0.753**	**good**	**99.9**	**0.963**	**0.540**	**0.920**
SAS-1	**4793**	**0**	**0.765**	**good**	**98.7**	**0.928**	**0.583**	**0.920**
MAD-HR-MRU-2	1769	0	0.813	high	59.7	0.989	0.637	
HRO313-ZUC	13	0						
HRO423-MOP	1756	0.016	0.813	high	59.7	0.989	0.637	
IT-SAS-1 (Ap-1)	1810	0	0.677	good	99.8	0.869	0.485	

SAU	Area	Total SAU weight	NEAT value	Status class	Confidence	CI14_Chla	CI13-TP	CI13-DIN
PU_2_C	1140	0.016	0.677	good	99.8	0.869	0.485	
PU_3_C	172	0						
PU_4_C	498	0						
MNE-SAS-1	568	0	0.892	high	100.0	0.920	0.823	0.920
MNE-1-N	86	0.001	0.828	high	85.0	0.852	0.804	
MNE-1-C	246	0.002	0.884	high	100.0	0.937	0.830	
MNE-1-S	151	0.001	0.945	high	100.0	0.956		0.933
MNE-Kotor	85	0.001	0.887	high	100.0	0.877		0.896
AL-SAS-1	646	0						
SAS-12	**43721**	**0**	**0.752**	**good**	**99.5**	**0.967**	**0.536**	
IT-SAS-12	22695	0	0.752	good	99.5	0.967	0.536	
PU_2_MC	1753	0.084	0.729	good	93.9	0.928	0.530	
PU_3_MC	1760	0.085	0.702	good	99.9	0.940	0.465	
PU_4_MC	3581	0.172	0.787	good	81.2	1.000	0.574	
PU_2_MO	2619	0						
PU_3_MO	6066	0						
PU_4_MO	6915	0						
MNE-SAS-12	5772	0						
MNE-12-N	468	0						
MNE-12-C	653	0						
MNE-12-S	781	0						
ME_SA_1_MO	3870	0						
AL-SAS-12	716	0						
MAD-EL-MS-AD	2253	0						
HR-SAS-12	12286	0						
HR_SA_1_MC	3397	0						
HR_SA_1_MO	8889	0						

4.2.3. The IMAP Environmental Assessment of the Central Mediterranean (CEN)

286. Aa explained above for AEL, at the stage of the present document finalization for consideration of the Meeting of CorMon on Pollution Monitoring, the assessment findings for the Alboran Sea, as the Sub-division of the WMS, and the Levantine Sea, as the Sub-division of the AEL, were finalized. The preparation of the remaining assessments at the level of the Subdivisions in the AEL, WMS, and CEN is foreseen within the finalization of the IMAP Pollution Cluster thematic assessments by applying the Simplified methodology based on G/M comparison.

4.2.4. The IMAP Environmental Assessment of the Western Mediterranean Sea (WMS)

<u>*Available data.*</u>

287. A detailed data analysis was performed for the Western Mediterranean Sea (WMS) in order to decide on the assessment methodologies that can be found optimal at the level of Sub-divisions given the present circumstances related to the lack of data reporting.

288. Table 4.2.4.1. informs on data availability in WMS by considering data reported in IMAP IS by 31st October, the cut-off date for data reporting. Figure 4.2.4.1 shows the locations of sampling stations in the WMS Sub-region

Table 4.2.4.1. Data availability by country and year for the WMS Sub-region showing data reported by the CPs for the assessment of EO5 (CI 13 and CI 14).

Country	Year	Amon	Ntri	Ntra	Phos	Tphs	Slca	Cphl	Temp	Psal	Doxy
Algeria	2016-2021	No data provided									
France	2016	-	-	-	-	-	-	130	179	179	74
	2017	66	-	66	66	-	43	130	324	340	116
	2018	56	-	56	56	-	56	129	326	326	108
	2019	126	-	126	126	-	126	126	344	342	117
	2020	102	-	102	102	-	95	120	349	350	129
Morocco	2016-2021	No valid data provided									
Italy	2015-2020	By 31st October 2022, Italy reported data relevant to the WMS Sub-region, in 4 data files with all together 1,081,853 data points up to 2019. On 17 Nov 2022 data for 2020 were also provided. Without building of a dedicated quality assured database, it is impossible to analyse the data availability and ensure their use for the assessment. It should be noted that quantum of data reported guarantees a near monthly sampling frequency on 27 profiles with 4 stations in the 5-year period. All IMAP mandatory parameters were measured.									
Spain	2019	8	86	86	95	-	-	95	95	95	95
	2020	306	311	311	295	-	-	290	304	304	310
	2021	300	300	300	141	-	-	294	302	302	302
	2022	274	322	322	168	-	-	291	318	318	318
Tunisia	2016-2021	No data provided									

Amon - Ammonium; Ntri- Nitrite; Ntra – Nitrate; Phos – Orthophosphate; Tphs—Total phosphorous; Slca – Orthosilicate; Cphl – Chlorophyll *a*; Temp – Temperature; Psal – Salinity; Doxy – Dissolved Oxygen.

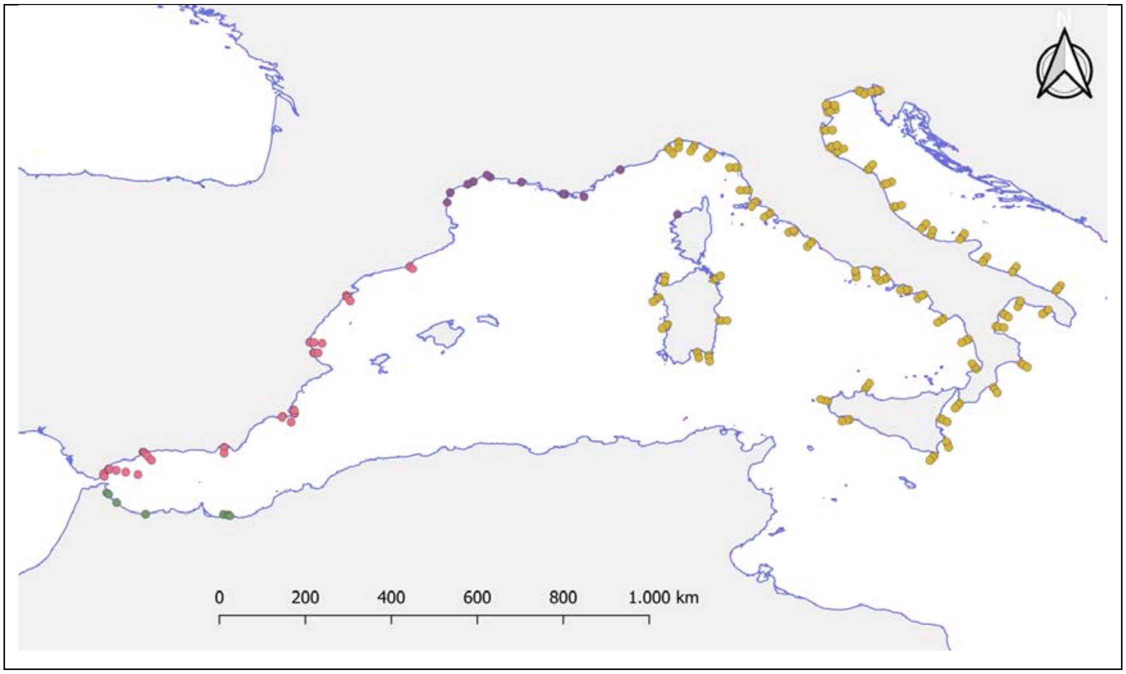


Figure 4.2.4.1. The locations of sampling stations in the WMS Sub-region

289. From Table 4.2.4.1. it is obvious that the CPs in the southern Mediterranean rim did not report data as required by Decision IG.23/6 of COP 20 related to the 2017 Mediterranean Quality Status Report, and Decision IG.24/4 of COP21 providing the 2023 MED QSR Roadmap implementation.

290. Morocco provided data related to one sampling undertaken in 2021. However, data were not compliant with the format of IMAP DDs and DSs. France, Italy and Spain reported data at the level shown in Table 4.2.4.1, however, only data of Italy can be utilized for the assessment as they comprise all the necessary parameters, and provide optimal geographical coverage and sampling frequency.

291. Considering data reported from Italy, as well as their significant quantum, but also the lack of data quality assurance performed at the level of IMAP IS, an effort will be made to provide their more advanced assessment within the expected work for the Tyrrhenian Sea.

292. France provided data for 12 stations of which only 6 can be used for the assessment since at these stations data were reported both for CI13 (Key nutrients) and CI14 (Chla). For other 6 stations only data for physical parameters (T, S, O2) were reported. The sampling frequency is near monthly, but the geographical coverage is poor as the stations are very close to the coast (from 10-300 m).

293. Spain reported data for 42 stations on 10 profiles extending offshore zone sometime beyond 20 km distance from the coastline. Most of IMAP mandatory parameters were provided. However, both Spain and France did not report data for Total phosphorus. The sampling frequency was two times per year that is not in line with the IMAP requirement, which for example in the best case of oligotrophic waters requires bimonthly frequency in the Coastal Waters (CW) and seasonal frequency in the Offshore Waters (OW).

294. Some of data were reported to IMAP IS very close to the 31st October, the cut-off date for data reporting, and without having a functional data quality control at the level of IMAP IS, at this late stage it was impossible to undertake data quality control and evaluation including through direct exchange with the CPs. A significant quantum of data reported also contributed to such situation.

a) The Alboran Sea (ALBS) Sub-division

Available data.

295. Given the above explained status of data reported in the WMS, in particular the lack of homogenous and quality assured data reported in line with IMAP requirements, it was necessary to explore the use of alternative data sources i.e. the COPERNICUS source. Chlorophyll *a* data for the Alboran Sea Sub-division, comprising of comprise of **7, 452, 245 records,** were downloaded from the Copernicus web-site[25]. Data were elaborated by using R, an open-source language as elaborated above in Section 4.2.1 (UNEP/MAP - MED POL, 2023). .

296. For every point of the grid (Figure 4.2.4.2), a GM annual value was calculated, as required in the COMMISSION DECISION (EU) 2018/229[26]. The parameter values were expressed in μg/l of Chlorophyll a, for the geometric mean (GM) calculated over the year in at least a five-year period. These GM annual values were later used as a metric for the development of the assessment criteria for the present CI 14 assessment.

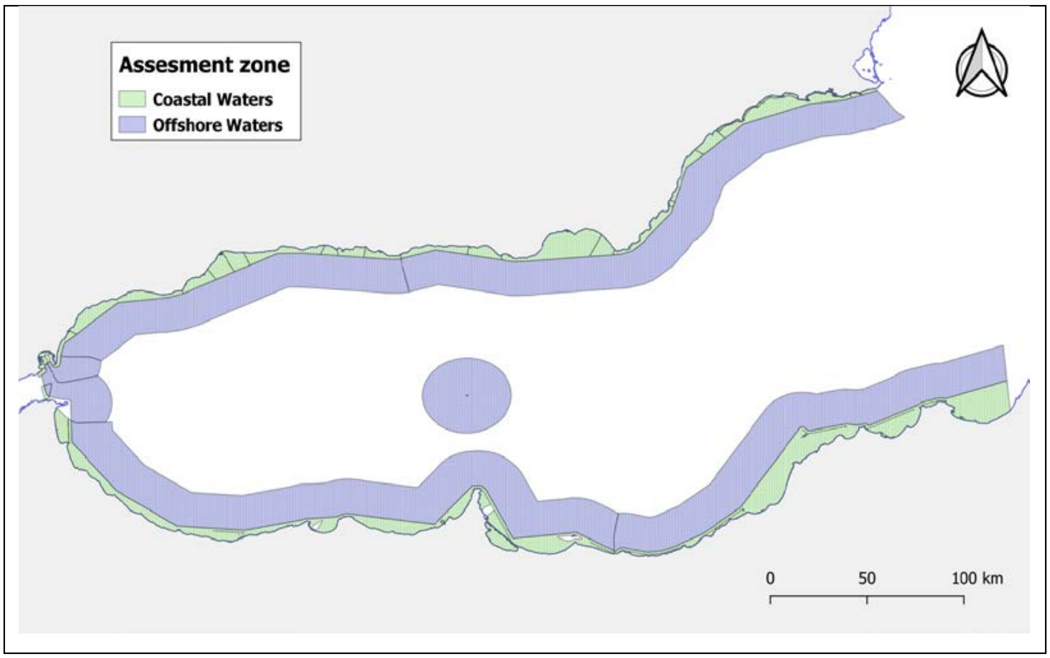


Figure 4.2.4.2. The Alboran Sea Sub-division: The dots in the assessment zones represent the data in the grid (1 x 1 km).

Setting the areas of assessment.

297. The two zones of assessment were defined in the Alboran Sea Sub-division for the purposes of the present work: i) the coastal zone and ii) the offshore zone by applying the same approach as applied to the Levantine Sea Sub-division (Section 4.2.1).

298. The principle of the NEAT IMAP GES assessment methodology was also followed for setting of the coastal (CW) and the offshore monitoring zones (OW) in the Alboran Sea Sub-division. The CW

[25] https://data.marine.copernicus.eu/product/OCEANCOLOUR_MED_BGC_L4_NRT_009_142/description
[26] Commission Decision (EU) 2018/229 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

included internal waters and one Nautical Mile outward. The offshore waters start at the outward border of CW and extend to 20 km outward given this coverage corresponds to the area where national monitoring programmes are performed as shown in Figure 4.2.4.1. In addition, the IMAP Spatial Assessment Units (SAUs) were set in the waters of Spain by taking account of the specific circulation pattern in the Alboran Sea which influences the biogeochemical processes in the area, as shown in Figure 4.2.4.3 (Sánchez-Garrido and Nadal, 2022[27]).

299. For purpose of the present work, it should also be recalled that GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase) were also used for Spain, Morocco and Algeria.

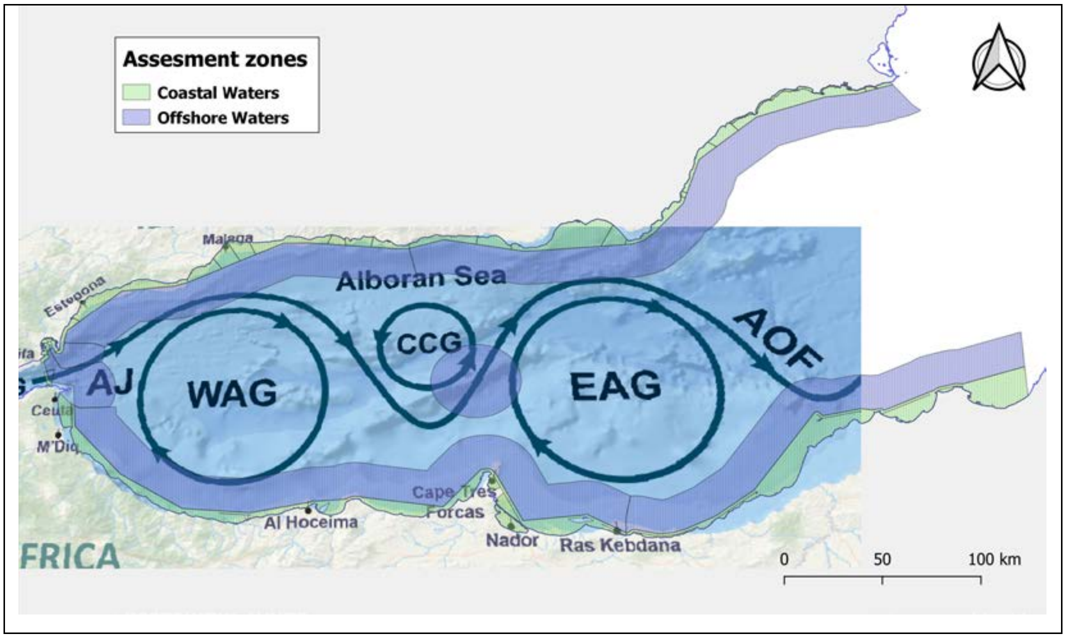


Figure 4.2.4. 3. A circulation scheme superimposed on the CW and OW assessment zones in the Alboran Sea Sub-division (Sánchez-Garrido and Nadal, 2022)

300. The Spanish OW were classified in in the ESPE (East of Motril) and the ESPW (West of Motril) as shown in Figure 4.2.4.4. (upper map). For the Spanish CW, the division to water bodies (WB), set for implementation of the WFD, was also used for setting IMAP SAUs. Consequently, the WFDs coding was used for present work as shown in Figure 4.2.4.4 (lower map).

301. For Morocco and Algeria any additional finer IMAP SAUs was not set.

302. Figure 4.2.4.4 depicts the finest IMAP SAUs (UNEP/MAP - MED POL, 2023) nesting in the two main assessment zones i.e. CW and OW of the Alboran Sea Sub-division.

[27] Sanchez-Garrido JC and Nadal I (2022) The Alboran Sea circulation and its biological response: A review. Front. Mar. Sci. 9:933390. doi: 10.3389/fmars.2022.933390

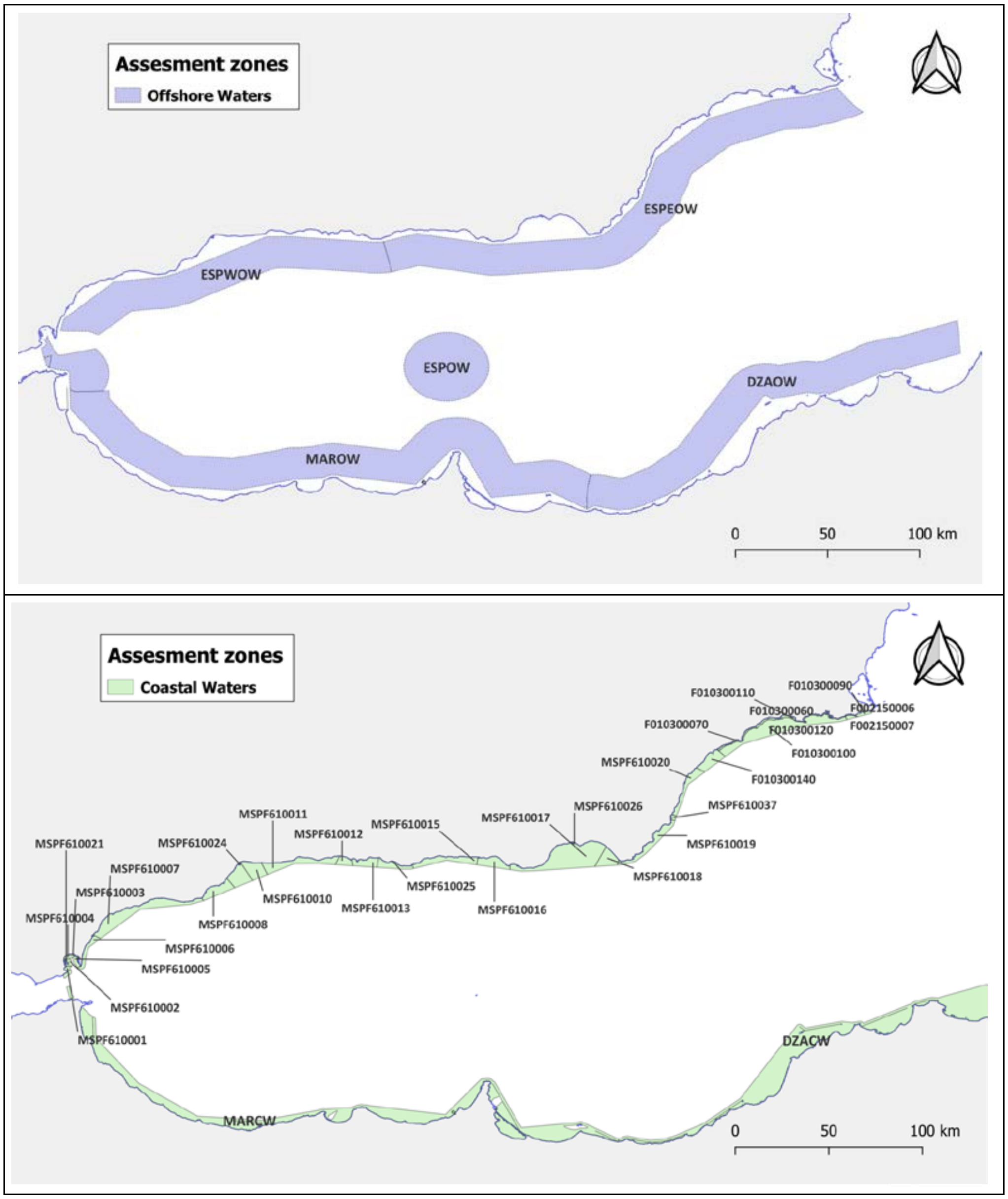


Figure 4.2.4.4. The nesting of the finest IMAP SAUs set for the Alboran Sea Sub-division in the OW assessment zone (upper map); and depiction of the finest IMAP SAUs set in CW assessment zone (lower map). For setting IMAP SAUs along the coast of Spain, the WFD water bodies were taken into account.

Setting the GES/non-GES boundary value/threshold for the Simplified G/M comparison assessment methodology application in the ALBS

303. Given the use of reference and boundary water types related values, as set by the Decision IG.23/6 of COP 20 (MED QSR), was impossible for the present work in the Alboran Sea Sub-division, the calculation of the assessment criteria applicable within the present work was undertaken, along with the normalization transformation (UNEP/MAP – MED POL, 2023), and above for the Levantine Sea Sub-division (Section 4.2.1).

304. The transformation of percentile to z-scores were obtained using the *pnorm()* an *qnorm()* functions in R. The RC values (oN10) and the G/M thresholds (oN85) were calculated from the normalized values through the *predict* function. The results of calculation are presented in Tables 4.2.4.2 and 4.2.4.3.

Table 4.2.4.2. Reference conditions (oN10) and G/M threshold (oN85) set by IMAP spatial assessment units in the Alboran Sea Sub-division.

Country	AZ	SAU	oN50	oN50+50	oN90	oN10	oN85	oN25
Algeria	CW	DZACW	0,117	0,175	0,190	0,102	0,158	0,107
Algeria	OW	DZAOW	0,103	0,155	0,111	0,097	0,109	0,100
Spain	OW	ESPOW	0,124	0,186	0,147	0,118	0,144	0,121
Spain	CW	ESPECW	0,142	0,213	0,213	0,100	0,186	0,114
Spain	OW	ESPEOW	0,102	0,152	0,153	0,083	0,146	0,088
Spain	CW	ESPWCW	0,311	0,466	0,533	0,203	0,471	0,234
Spain	OW	ESPWOW	0,202	0,303	0,264	0,161	0,254	0,185
Morocco	CW	MARCW	0,184	0,277	0,397	0,119	0,320	0,153
Morocco	OW	MAROW	0,127	0,191	0,145	0,103	0,140	0,118

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile, oN85 – 85th percentile, oN25 – 25th percentile

Table 4.2.4.3. Reference conditions (oN10) and G/M threshold (oN85) set by IMAP SAUs along the Spanish cost given their finer spatial level to ensure harmonization with WFD Water bodies of Spain.

Country	AZ	SAU	SAU(WFD_WB)	oN50	oN50+50	oN90	oN10	oN85	oN25
Spain	CW	ESPE	ES060MSPF610015	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES060MSPF610016	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES060MSPF610017	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES060MSPF610018	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES060MSPF610019	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES060MSPF610020	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES060MSPF610037	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES070MSPF002150007	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES070MSPF010300080	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES070MSPF010300090	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES070MSPF010300100	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES070MSPF010300110	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPE	ES070MSPF010300140	0,142	0,213	0,213	0,100	0,186	0,114
Spain	CW	ESPW	ES060MSPF610000	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610002	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610005	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610006	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610007	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610008	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610009	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610010	0,311	0,466	0,533	0,203	0,471	0,234

Spain	CW	ESPW	ES060MSPF610011	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610012	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610013	0,311	0,466	0,533	0,203	0,471	0,234
Spain	CW	ESPW	ES060MSPF610014	0,311	0,466	0,533	0,203	0,471	0,234

oN50 – Mean, oN50+50 – Mean + 50%, oN90 – 90th percentile, oN10 – 10th percentile,

oN85 – 85th percentile, oN25 – 25th percentile

305. As explained above (Sections 2 and 4.2.1), the compatibility of the present classification was achieved with a five classes GES/non GES scale set in the Adriatic Sea Sub-region.

Results of the Simplified G/M comparison assessment methodology application in the ALBS

306. Upon setting the reference conditions and the G/M threshold, each observation point, or area were classified in GES or non-GES, by comparing the value of the indicator i.e., the satellite derived Chl*a* to the G/M threshold, i.e. the back transformed 85th percentile of normalized distribution.

307. The results of CI 14 assessment using the satellite derived Chl*a* data are presented in Tables 4.2.4.4. and 4.2.4.5, and Figure ALBS 5.1.1.E. The likely GES (Table 2.5.2.b.) corresponds to the RC conditions, as well as to the values below the 85th percentile of normalized distribution set as GES/non GES boundary (i.e. blue coloured cells in the last column of Tables 4.2.4.4. and 4.2.4.5). The likely non GES corresponds to the class above G/M boundary limit (i.e. red coloured cells in the last G_nG.oN85 column of Tables 4.2.4.4. and 4.2.4.5). The assessment results show that all evaluated assessment zones can be considered likely in GES regarding assessment of the satellite derived Chl*a* data.

308. Despite likely GES assigned to the assessment zones, it should be noted that in the CW assessment zone of Spain (4.2.4.5. and Figure ALBS 5.1.1.E), for which the finest SAUs were defined in line with WFD, there are 4 out of 26 SAUs which are likely in nonGES. One SAU is located close to the Gibraltar strait (ES060MSPF610002), the two SAUs (ES060MSPF610015 and ES060MSPF610016) are located in the ESPE close to the line dividing the CW to the eastern and western part of the assessment zone, and the most eastern SAU (ES070MSPF010300090) is located close to the Mar Menor lagoon. The local sources of pollution are probably the main driver contributing to the weakened status of the first and the last SAUs. Wider biogeochemical processes can contribute to the weekend status of other two SAUs, located near to local sources, close to the line dividing the CW to the eastern and western assessment zones.

309. An additional assessment was tentatively performed by applying the Simplified G/M comparison assessment methodology on every satellite derived Chl*a* point of the data grid (ALBS 5.1.2.E). Due to the high geographical variability of the biogeochemical processes at such scale (1 x 1 km), this assessment provided only an indication of the environmental status in ALBS. The points in the grid with the concentrations of the satellite derived Chl*a* data lower than the RC values were also plotted.

310. This additional analysis supports identification of the main biogeochemical, controlling processes in the ALBS. It indicates impacts of the waters entering the Mediterranean through the Gibraltar Strait with different nutrient load. It also indicates the accumulation of organic materials between the two gyres (Figure 4.2.4.3, north of the Central Circulation Gyre). The influence of the returning current is also identified along the southern coast of the ALBS, resulting in increased value along the Moroccan and Algerian coast. Finally, the analysis confirms the local influence of the Nador lagoon.

311. The additional assessment results also show the potential of using the satellite derived Chl*a* data for GES assessment. This encourages future decision-making regarding inclusion of an additional sub-indicator i within the monitoring of CI 14. Namely, coupling of satellite derived Chl*a* data with Chl*a* concentrations measured *in situ* would greatly enhance the IMAP monitoring.

Table 4.2.4.4. Results of the assessment (G_nG.oN85 - the GES class corresponding to all values below the 85th percentile set as GES/non GES boundary limit) of the Alboran Sea Sub-division by Assessment Zones (AZ) and Spatial Assessment Units (SAUs). Blu coloured SAUs indicates likely in GES, Red coloured SAUs indicate likely in non GES.

Country	AZ	SAU	CHL_N	CHL_GM	oN50	oN50+50	oN10	oN85	G_nG.oN85
Algeria	CW	DZACW	1251	0,131	0,117	0,175	0,102	0,158	**G**
Algeria	OW	DZAOW	3810	0,105	0,103	0,155	0,097	0,109	**G**
Spain	OW	ESPOW	1740	0,129	0,124	0,186	0,118	0,144	**G**
Spain	CW	ESPECW	959	0,147	0,142	0,213	0,100	0,186	**G**
Spain	OW	ESPEOW	4591	0,109	0,102	0,152	0,083	0,146	**G**
Spain	CW	ESPWCW	517	0,321	0,311	0,466	0,203	0,471	**G**
Spain	OW	ESPWOW	2829	0,207	0,202	0,303	0,161	0,254	**G**
Morocco	CW	MARCW	1133	0,211	0,184	0,277	0,119	0,320	**G**
Morocco	OW	MAROW	5169	0,126	0,127	0,191	0,103	0,140	**G**
CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5-year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10th percentile (Reference conditions);									

Table 4.2.4.5. Result of the assessment (G_nG.oN85 - the GES class corresponding to all values below the 85th percentile set as GES/non GES boundary limit) of the Spanish CW in the Alboran Sea Sub-division for the finest Spatial Assessment Units (SAUs). Blu coloured SAUs indicate likely in GES, Red coloured status indicate – likely in non GES.

Country	AZ	SAU	SAUs(WFD_WB)	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_N.G.oN85
Spain	CW	ESPE	ES060MSPF610015	73	0,193	0,213	0,100	0,186	**NG**
Spain	CW	ESPE	ES060MSPF610016	55	0,202	0,213	0,100	0,186	**NG**
Spain	CW	ESPE	ES060MSPF610017	332	0,179	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES060MSPF610018	62	0,146	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES060MSPF610019	58	0,124	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES060MSPF610020	29	0,133	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES060MSPF610037	3	0,116	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES070MSPF002150007	6	0,139	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES070MSPF010300080	1	0,164	0,213	0,100	0,186	**G**
Spain	CW	ESPE	ES070MSPF010300090	5	0,222	0,213	0,100	0,186	**NG**
Spain	CW	ESPE	ES070MSPF010300100	277	0,113	0,213	0,100	0,186	**G**

Country	AZ	SAU	SAUs(WFD_WB)	CHL_N	CHL_GM	oN50+50	oN10	oN85	G_N.G.oN85
Spain	CW	ESPE	ES070MSPF010300110	3	0,174	0,213	0,100	0,186	G
Spain	CW	ESPE	ES070MSPF010300140	55	0,111	0,213	0,100	0,186	G
Spain	CW	ESPW	ES060MSPF610000	1	0,186	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610002	3	0,603	0,466	0,203	0,471	NG
Spain	CW	ESPW	ES060MSPF610005	2	0,468	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610006	9	0,379	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610007	137	0,406	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610008	46	0,343	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610009	74	0,283	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610010	71	0,314	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610011	85	0,334	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610012	21	0,238	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610013	33	0,217	0,466	0,203	0,471	G
Spain	CW	ESPW	ES060MSPF610014	35	0,229	0,466	0,203	0,471	G

CHL_N – number of grid point in the SAU; CHL_GM – geometric mean (5 year average); oN50 – mean; oN50+50 – Mean + 50%; oN10 – 10^{th} percentile (Reference conditions); oN85 – 85^{th} percentile (G/nonG threshold)

4.3. Assessment of IMAP Common Indicator 17: Concentration of key harmful contaminants measured in the relevant matrix (EO9)

Geographical scale of the assessment	The Sub-regions within the Mediterranean region based on integration and aggregation of the assessments at Sub-division levels
Contributing countries	In alphabetical order: Albania, Algeria*, Croatia. Cyprus, France, Greece. Israel, Italy, Lebanon, Malta, Montenegro. Morroco, Slovenia, Spain, Tunisia*, Türkiye (*data from the literature)
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI17. Level of pollution is below a determined threshold defined for the area and species
GES Definition (UNEP/MED WG 473/7) (2019)	Level of pollution is below a determined threshold defined for the area and species
GES Targets (UNEP/MED WG 473/7) (2019)	• Concentrations of specific contaminants below Environmental Assessment Criteria (EACs) or below reference concentrations • No deterioration trend in contaminants concentrations in sediment and biota from human impacted areas, statistically defined • Reduction of contaminants emissions from land-based sources
GES Operational Objective (UNEP/MED WG473/7) (2019)	Concentration of priority contaminants is kept within acceptable limits and does not increase

4.3.1. The IMAP Environmental Assessment of the Aegean and Levantine Seas (AEL) Sub-region

312. The assessment of the of the Aegean and Levantine Seas (AEL) Sub-region is provided by using the CHASE+ (Chemical Status Assessment Tool) methodology for the Aegean Sea (AEGS) Sub-division and the Levantine Sea (LEVS) Sub-division. The assessment findings included in the IMAP Pollution 2023 MED QSR Chapter are based on the thematic assessments (UNEP/MAP MED POL, 2023).

a) <u>The Aegean Sea (AEGS) Sub-division</u>

<u>Available data.</u>

313. Data for the AEGS were available only for the sediment matrix. Table 4.3.1.1.a summarizes the available data. Trace metals (TM – Cd, Hg and Pb) in sediments were reported for 32 stations by Türkiye (2018), while data for Cd and Pb were reported for 34 stations by Greece, i.e. for 5 stations in 2019 and 29 stations in 2020. In addition, Pb data were available for 28 stations located in the area of the Saronikos Gulf and Elefsis Bay for 2018 (Karageorgis et al. 2020a, Karageorgis et al. 2020b). Individual concentrations of each of the 16 required PAHs were reported by Greece (11 stations in 2019 and 10

stations in 2020) as well as for Σ_{16} PAHs. Data for Σ_5 PAHs[28] were reported by Türkiye for 32 stations sampled in 2018. Concentrations of total PCBs (Σ_7 PCBs[29]), individual concentrations for each PCB congener, Lindane and Dieldrin were reported for 31 stations by Türkiye (2018).

314. The data were compiled from the IMAP-IS, as reported by 31st October 2022. As mentioned, additional data from the scientific literature were also used (Karageorgis et al., 2020 a,b).

Table 4.3.1.1.a. Data available for the assessment of the AEGS sub- division. Only data for the sediment matrix were available.

Source	IMAP-File	Country	Sub-division	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin
Sediment												
IMAP_IS	446	Turkey	AEGS	2018	32	32	32	0	32	31	31	31
IMAP_IS	652	Greece	AEGS	2019	5	0	5	11	11	11	0	0
IMAP_IS	652	Greece	AEGS	2020	29	0	29	10	10	10	0	0
Lit[1]		Greece	AEGS	2018	0	0	28	0	0	0	0	0

[1]Karageorgis et al, 2020 a,b

315. Based on the available data, the assessment was performed for TM, Σ_{16} PAHs and Σ_7 PCBs in sediment. In addition, the AEGS was assessed based on Σ_5 PAHs as well. This is not a mandatory parameter but was included in the assessment given significant more data available for Σ_5 PAHs compared to Σ_{16} PAHs (53 vs 21 data points, respectively) encompassing a larger area of the AEGS. Therefore, we made an exception to possibly increase confidence of the assessment. When possible, a qualitative description was provided for the additional parameters or stations.

Setting the GES/non-GES boundary value/threshold for the CHASE+ application in the AEGS.

316. The thresholds used for the CHASE+ assessment methodology were the updated sub-regional BACs as approved by the Meeting of CorMon Pollution (27 and 30 May 2022) (UNEP/MAP – MED POL 2022)[30.] Table 4.3.1.2.a summarizes the thresholds values, the same ones used in the assessment of LEVS subdivision within the Aegean Levantine Seas Sub-region (AEL) (UNEP/MAP - MED POL, 2023).

Table 4.3.1.2. a. Summary of the threshold values used in present pilot application for GES assessment of the Levantine and Aegean Seas sub-divisions. MedEACs are presented for comparison.

	AEL_BAC	MED_BAC	MedEAC
Sediments, µg/kg dry wt			
Cd	118	161	1200
Hg	47.3	75	150
Pb	23511	22500	46700
Σ_{16} PAHs	41	32	4022*
Σ_5 PAHs^	17.2	31.8	

[28] Σ_5 PAHs is the sum of the concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and Benzo(ghi)perylene. Turkiye reported also the concentration of Σ_4PAHs that is the sum of the first 4 compounds in Σ_5 PAHs. Both Σ5 PAHs and Σ4 PAHs are non-mandatory parameters for CI 17, whereby Σ16 PAHs, is a mandatory parameter.
[29] PCBs congeners 28,52,101,118,132,153,180
[30] MED_BACs were adopted by 2017 COP, while the use of sub-regional BACs within the preparation of the 2023 MED QSR was approved by the Meeting of CorMon Pollution held on 27 and 30 May 2022

Σ_7 PCBs	0.19	0.40	68+

* ERL value derived for the sum of 16 PAHs by Long et al., 1995, do not appear in the Decisions of COP. + sum of the individual MedEACs values of the 7 PCB compounds as they appear in Decision IG.23/6;^ Values are not set by Decision IG.22/7, therefore the BAC value for Σ_5 PAHs is calculated as a sum of the individual BAC values as provided for the 5 PAHs compounds.

317. The boundaries between the 5 environmental classification classes (i.e. high, good, moderate, poor and bad) are given in Table 2.5.2.a., Section 2.

Integration of the areas of assessment for the AEGS.

318. The locations of the sampling stations are presented in Figures AEGS 5.2.1.C - AEGS 5.2.4.C (Section 5).

319. The locations of the sampling stations were sorted by group of contaminants. As explained above, data were available only for the sediment matrix. Data for TM, PAHs were reported by Türkiye at each of the 32 sampling stations, as well as for PCBs in sediments at 31 out of the 32 sampling stations. Data for Cd and Pb were reported by Greece at 34 stations and for PAHs at 15 of these stations. In addition, data for 6 stations with only PAHs concentration were reported. Additional data from the literature (Karageorgis et al., 2020) for Pb only were available for 28 stations.

320. Further to IMAP implementation, the monitoring stations were considered for grouping in the two main assessment zones i.e., the coastal (within 1 nm from the shore) and offshore zones. Twenty-one stations in Türkiye were coastal and 11 belonged to the offshore zone. In Greece, 35 stations were classified as coastal and 31 as offshore. Due to the limited number of data points, more so if dividing into coastal and offshore stations, the spatial nesting of stations in spatial assessment units (SAUs) to the level considered meaningful for IMAP CI 17 was not possible in AEGS. Spatial nesting would decrease the reliability and the representativeness of each station for the assessment of the Aegean Sea Sub-division. Therefore, at this stage, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.

Results of the CHASE+ Assessment of CI 17 in the Aegean Sea Sub-division.

321. For each measured parameter at each station a contamination ratio (CR) was calculated. Thresholds were the updated sub-regional AEL_BACs (Table 4.3.1.2.a). CHASE+ methodology in the AEGS was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, aggregation was possible only for TM in sediments, and only partially. A contamination score (CS) aggregating 2-3 metals was further calculated. Table 4.3.1.3.a. summarizes the results of the CHASE+ application (UNEP/MAP – MED POL, 2023) .

Table 4.3.1.3.a. Number of data points and their percentage from the total number of data points in each category based on the CHASE+ tool, calculated using the new AEL_BACs (UNEP/MAP - MED POL, 2023) .

CHASE+		**Blue** **High**	**Green** **Good**	**Yellow** **Moderate**	**Brown** **Poor**	**Red** **Bad**
		NPA or GES		**PA or non-GES**		
Sediment	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
Cd, Hg, Pb	94*	23	40	18	11	2
% from total number of data points		*24*	*43*	*19*	*12*	*2*
		CR=0.0-0.5	**CR=0.5-1.0**	**CR =1.0-2**	**CR =2-5**	**CR>5**
Σ_{16} PAHs	21	3	6	3	4	5
% from total number of data points		*14*	*29*	*14*	*19*	*24*
Σ_5 PAHs	53	19	9	7	10	8
% from total number of data points		*36*	*17*	*13*	*19*	*5*
Σ_7 PCBs	31	17	5	3	3	3
% from total number of data points		*55*	*16*	*10*	*10*	*10*

*32 stations reported all the 3 TMs, 34 only Cd and Pb and 28 only Pb.

Assessment of Trace metals in sediments of the AEGS.

322. As explained above, only for 32 stations data were reported for all the 3 TMs. For 34 stations data were reported only for Cd and Pb and for 28 stations only for Pb. A detailed examination of the CRs for the individual metals, found that mainly Pb and to a lesser degree Cd, contributed to the classification of 2 out of 94 stations, as in bad status. One was located in the inner Saronikos Gulf (CW36) and one in the Northern Aegean (CW54) (Figure AEGS 5.2.1.C, Section 5;). Eleven stations were classified as in poor status: 8 in the Elfsis Bay and inner Saronikos Gulf, due to elevated Pb concentrations, one (CW32) in the Elfsis Bay due to Pb and to a lesser degree Cd. Two stations, i.e. ALISW2, CABSSW1, in the vicinity of Aliaga and Yenisakran, were classified as poor mainly due to elevated Hg concentrations. Using CS, 18 stations were classified as moderate and they were distributed across the AEGS. No specific, demarcated area could be classified as non-GES based on these 18 stations. The 63 remaining stations were classified in the high and good statuses (in-GES). Six stations for which data were reported by Türkiye, defined as reference stations, were in the high status (2 stations) and in the good status of classification (4 stations).

323. Fifteen out of the 31 stations classified as non-GES were located in the Elfsis Bay and inner Saronikos Gulf, known to be impacted by anthropogenic activities (Table AEGS1, Annex II). This area is the seaward boundary of the metropolitan areas of Athens and Piraeus port, hosting 1/3 of the current Greek population (3.2 million people; Census 2011). More than 40% of the Greek industries are located in the coastal area of the Elefsis Bay, including some of the biggest plants of the country, such as oil refineries, steel and cement industries, and shipyards (Karageorgis et al., 2020 and references therein). Increased concentrations of trace elements in this area, resulting from the discharges of domestic and industrial effluent, have been documented since the late 1970s. The major sources of pollution were identified as the Psyttaleia wastewater treatment plant, a fertilizer plant- operating in the Inner Saronikos Gulf until 1999, steel mills and shipyards in the Elefsis Bay. The contamination found in the bay has resulted in the accumulation of metals in mussel tissues, which followed a spatial gradient related to land-based sources. Karageorgis et al. 2020 found maximal Pb concentrations (in conjunction with Cu, Zn and As) in the Elefsis Bay and the Psyttaleia Island region, with N-S decreasing trends. Minor Pb enrichment was recorded at the deeper sector of the Outer Saronikos Gulf. A temporal (1999–2018) decrease in metal concentrations was found for 2 out of the 14 stations sampled in the Elefsis Bay. Several polluting industries have ceased their operation during the last decade. Therefore, the decreasing trend in the most industrialized part of the study area is connected to the reduction of metal discharges in the coastal environment. Furthermore, environmental policy enforcement combined with technological improvements by big industrial polluters, such as the steel-making industry have contributed to the improvement of sediment quality.

324. The 16 stations classified as non-GES (out of the 31) were distributed in the northern and central part of the AEGS. Most stations were located in bays (Table 4.3.3.a; Figure AEGS 5.2.1.C, Section 5; UNEP/MAP – MED POL, 2023), where usually the water exchange is slower than in open waters, promoting accumulation of land-based source contaminants. The 67 stations classified in GES (high and good status) were distributed along the whole AEGS sub-division (Figure AEGS 5.2.1.C, Section 5).

Assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments of the AEGS

325. Σ_{16} PAHs in sediments: There were only 21 stations with data for Σ_{16} PAHs in sediments, and data for all of them were reported by Greece. It can be seen (Table 4.3.1.3.a; Figure AEGS 5.2,2.C, Section 5; UNEP/MAP – MED POL, 2023) that the stations located offshore are in-GES (8 stations, 38% of total stations), while the stations located in enclosed areas, except one, are classified as non-GES (12 stations, 57% of total stations). However, this is based on data from only 21 stations, which is not enough for a confident assessment. Additional data are needed to improve the assessment and to better delimit possible non-GES areas.

326. Σ_5 PAHs in sediments: There were only 21 stations with data for Σ_{16} PAHs in sediments, however Türkiye reported data for Σ_5 PAHs[31] for 32 stations. Although Σ_5 PAHs is not a mandatory parameter, the assessment based on it was performed due to significant more data availability for Σ_5 PAHs compared to Σ_{16} PAHs (53 vs 21 data points, respectively) encompassing a larger area of the AEGS. Therefore, an exception was made in order to increase confidence of the assessment.

327. For the stations with available data for Σ_{16} PAHs, the assessment performed using Σ_5 PAHs was identical to the assessment based on Σ_{16} PAHs (Figure AEGS 5.2.2.C, Section 5), except for one station, CW41 that was now classified as in good status instead of in moderate status (UNEP/MAP – MED POL, 2023). Out of the 53 available stations, about half (28 stations, 53% of the total stations) were classified in-GES (high and good statuses) for Σ_5 PAHs in sediments, and about half (25 stations, 47% of the total

[31] Σ_4 PAHs was also reported, but it was decided to assess the status based on Σ_5 PAHs given it encompasses all 4 PAHs; Both Σ5 PAHs and Σ4 PAHs are non-mandatory parameters for CI 17, whereby Σ16 PAHs, is a mandatory parameter.

stations) as not in-GES (moderate, poor and bad statuses) (Figure AEGS 5.2.3.C, Section 5; UNEP/MAP – MED POL, 2023).

328. Therefore, as a whole, there are indication that AEGS might be classified as non-GES regarding Σ_5 PAHs in sediments. However, only 2 limited affected areas were identified in non-GES, similarly to the assessment of TM in sediments: 1) the Elfsis Bay and inner Saronikos Gulf and 2) the area encompassing the coast around Kucukkoy, Dikili, Candarli, Aliaga, and Yenisakran. Most of the stations in the southern part of the AEGS were found in GES.

Assessment of Σ_7 PCBs in sediments of the AEGS

329. Data on PCBs were reported only by Türkiye. The northern (except station D7 in the Dardanelles Strait) and southern part of the coast were in GES regarding Σ_7 PCBs in sediments (22 stations, 71% from the total number of stations) (Figure AEGS 5.2.4.C, Section 5; UNEP/MAP – MED POL, 2023). The mid area, encompassing the coast around Aliaga, Yenisakran and Candarli was classified as non-GES, in particular the stations inside the bay (9 stations, 29% from the total number of stations) which determined this area as an affected one. There are not enough data to classify the whole AEGS sub-division regarding data reported for Σ_7 PCBs in sediments.

330. Key finding. The AEGS sub-division could not be classified regarding assessment of Σ_7 PCBs in sediments due to lack of data. An affected, non-GES area was identified in the coast around Aliaga, Yenisakran and Candarli. The north-eastern and south-eastern coast were in-GES regarding assessment of data on Σ_7 PCBs in sediments.

Organochlorinated contaminants other than PCBs in sediments of the AEGS

331. Data for Organochlorinated contaminants were reported only by Türkiye. Dieldrin in all stations were below detection limit (reported as 0 μg/kg dry wt) while data for γ-HCH (Lindane) ranged from below detection limit to 0.14 μg/kg dry wt with an average and median concentration of 0.036 and 0.013 μg/kg dry wt, respectively. The BAC value is not set for Lindane. Only EAC of 3 μg/kg dry wt was adopted by Decision IG.22/7. The concentrations reported for Lindane were well below the EAC value.

b) The Levantine Sea Sub-division (LEVS)

Available data.

332. The available data for the assessment of the Levantine Sea are presented in Table 4.3.1.1.b Data were available for TM (Cd, Hg and Pb) in sediments as available for Cyprus, Greece, Israel, Lebanon, Türkiye; TM in the fish *M. barbatus* as available for Cyprus, Israel, Lebanon, Türkiye; PAHs in sediments as available for Greece, Israel, Lebanon and Türkiye; some PAH compounds for *M. barbatus* as available for Cyprus and Türkiye; organochlorinated contaminants in sediments as available for Lebanon and Türkiye; and organochlorinated contaminants in *M. barbatus* as available for Cyprus, Lebanon and Türkiye.

333. No data were available for the southern coast nor for the southern offshore area of the LEVS.

334. The most data were available for TM in sediments. There were 136 data points in the database, with 135 data points for Cd, 133 for Hg and 136 for Pb. Data for TM in *M. barbatus* were as follows: 83 data points for Cd, 85 data points for Hg and 39 data points for Pb. Data for PAHs in sediments were available for 112 stations. Data on total 16 PAHs (Σ_{16} PAHs) in sediments were reported for 75 stations while for 33 stations the data available were for Σ_5 PAHs[32]. Data for some of the PAHs compounds in *M.*

[32] Σ_5 PAHs is the sum of the concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and Benzo(ghi)perylene. Turkiye reported also the concentration of Σ_4PAHs that is the sum of the first 4 compounds in Σ_5 PAHs. Both Σ_5 PAHs and Σ_4 PAHs are non-mandatory parameters for CI 17, whereby Σ_{16} PAHs, is a mandatory parameter.

barbatus were reported in 18 specimens. Data for total PCBs (Σ_7 PCBs[33]) in sediments were available for 52 stations. Data for Lindane and Dieldrin in sediments were available for 33 stations. In *M. barbatus* data for Σ_7 PCBs, Lindane, Dieldrin, Hexachlorobenzene and p,p'DDE were available in 12 samples.

335. The data were compiled from the IMAP-IS, as reported by 31st October 2022. As mentioned, additional data from the scientific literature were also used (Astrahan et al. 2017, Ghosn et al, 2020).

Table 4.3.1.1.b. Data available for the assessment of the LEVS Sub-division.

Source	IMAP_File	Country	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin
Sediment											
IMAP_IS	497	Cyprus	2017	7	7	7					
IMAP_IS	497[34]	Cyprus	2018	4	4	4					
IMAP_IS	634	Cyprus	2019	2	2	2		2			
IMAP_IS	634	Cyprus	2020	6	6	6		6			
IMAP_IS	634	Cyprus	2021	6	5	6					
IMAP_IS	652	Greece	2019	3	0	3	4*	4			
IMAP_IS	588	Israel	2020	14	14	14					
IMAP_IS	531[35]	Israel	2019	16	16	16					
MED POL		Israel	2017	14	14	14					
IMAP_IS	585	Israel	2018	11	11	11					
Lit[1]		Israel	2013&				52*	52			
IMAP_IS	118	Lebanon	2019	17	17	17	19		19		
Lit[2]		Lebanon	2017	2	3	3					
IMAP_IS	445	Türkiye	2018	33	33	33		33	33	33	33
M. barbatus											
IMAP_IS	636	Cyprus#	2020	6	6	0		6	8	8	8
IMAP_IS	636	Cyprus#	2021	8	8	0		6	4	4	4
IMAP_IS	585[36]	Israel	2018	13	13	0					
IMAP_IS	410	Israel	2019	7	7	0					
IMAP_IS	588	Israel	2020	10	12	0					
IMAP_IS	152	Lebanon	2019	14	14	14		6	3		
IMAP_IS	323	Türkiye	2015	25	25	25	25^				

[1]Astrahan et al. 2017; [2]Ghosn et al, 2020; * Data for individual concentrations for all congeners are available; ^Data for 8 congeners available for 25 samples in 5 stations; # Additional data available for Hexachlorobenzene and DDE(p,p'). & Data from 2013 were used because no newer data were available; In addition, the stations are located offshore, at depths deeper than 100 m, so that temporal changes are not expected.

336. Based on the available data, the assessment was performed for TM, Σ_{16} PAHs and Σ_7 PCBs in sediment and for TM in *M. barbatus*. In addition, the LEVS was assessed regarding Σ_5 PAHs as well. This is not a mandatory parameter, but it was included in the assessment given data availability for Türkiye, that increased the coverage of the assessment over a larger area of the LEVS. Therefore, an exception was made to possibly increase confidence of the assessment. When possible, a qualitative description was provided for the additional parameters or stations.

Setting the GES/non-GES boundary value/threshold for the CHASE+ application in the LEVS.

337. The thresholds used for the CHASE+ assessment methodology were the updated sub-regional BACs, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022). If the Sub-regional BAC

[33] PCBs congeners 28,52,101,118,132,153,180
[34] Replaced IMAP file 125
[35] Replaced IMAP file 410
[36] Replaced IMAP file 71

was not available, the regional MED_BACs were used as thresholds in the present assessment (UNEP/MAP - MED POL, 2022). Table 4.3.1.2.b summarizes the thresholds values, the same ones used in the assessment of AEGS sub-division within the Aegean Levantine Seas Sub-region (AEL).

Table 4.3.1.2.b. Summary of the threshold values used in present pilot application for GES assessment of the Levantine and Aegean Seas sub-divisions. MedEACs are presented for comparison.

	AEL_BAC	MED_BAC	MedEAC
Sediments, µg/kg dry wt			
Cd	118	161	1200
Hg	47.3	75	150
Pb	23511	22500	46700
Σ_{16} PAHs	41	32	4022*
Σ_5 PAHs^	17.2	31.8	
Σ_7 PCBs	0.19	0.40	68+
***M. barbatus*, µg/kg wet wt**			
Cd	7.2	7.8	50
Hg	67.4	81.2	1000
Pb	27	36.6	300

* ERL value derived for the sum of 16 PAHs by Long et al., 1995, do not appear in the Decisions of COP; + sum of the individual MedEACs values of the 7 PCB compounds as they appear in Decision IG.23/6;^Values are not set by Decision IG.23/6, therefore the BAC value for Σ5 PAHs is calculated as a sum of the individual BAC values as provided for the 5 PAHs compounds.

338. The boundaries between the 5 environmental classification classes (i.e. high, good, moderate, poor and bad) are given in Table 2.5.2.a., Section 2.

Integration of the areas of assessment for the LEVS

339. The locations of the sampling stations are presented in Figures LEVS 5.2.1.C – LEVS 5.2.5. C (Section 5).

340. The locations of the sampling stations were sorted by group of contaminants. TM, PAH and Organochlorinated contaminants in sediments for Lebanon and Türkiye were determined in samples collected from the same stations at the same date. PAHs in sediments from Israel were collected from stations different from the stations sampled for TM in sediments and at a different date. The sampling sites for the fish *M. barbatus* in Lebanon, Israel and Türkiye were located in the areas close to the sediment samples, but did not encompass one specific station, only a fishing area. In Cyprus, one of the two sampling sites for the fish *M. barbatus* was located close to sediment stations and one far from sediment stations.

341. Further to IMAP implementation, the monitoring stations were considered for grouping in the two main assessment zones i.e., the coastal (within 1 nm from the shore) and offshore zones. The sampling stations for TM in sediments for Israel can be considered all coastal, except 2 stations that can be considered offshore stations. In Lebanon, 5 out of 20 stations can be considered offshore stations. In Cyprus, 8 stations can be considered coastal and 3 stations as offshore. In Greece, 1 station was coastal and 3 stations were offshore stations. In Türkiye, four stations can be considered offshore stations. The stations in Iskenderun Bay, Antalya Bay, the bay off Mersin and Erdemli and inlets can be considered coastal stations. No stations with data for PAHs in sediments in Israel can be considered coastal i.e. there were 52 stations that can be considered offshore stations. The grouping of stations for PAHs and organochlorinated contaminants in sediments for Lebanon and Türkiye was the same as for TM. TM in *M. barbatus* were determined in samples collected from stations that can be considered offshore stations in Israel, Cyprus and Lebanon. In Türkiye all stations can be considered coastal, with exception of one station that can be classified as offshore station. Due to the limited number of data points, more so if dividing into coastal and offshore stations, the spatial nesting of stations in spatial assessment units (SAUs) to the level considered meaningful for IMAP CI 17 was not possible in LEVS. Spatial nesting

would decrease the reliability and the representativeness of each station for the assessment of the Levantine Sea Sub-division. Therefore, at this stage, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.

Results of the CHASE+ Assessment of CI 17 in the Levantine Sea Basin

342. Data were grouped per parameter, matrix, station location and sampling year. In the cases where a station was sampled during various years, and/or there were more than one data point for the station at a certain year, the average concentrations (i.e., arithmetic mean) were calculated and used in the CHASE+ assessment. Average concentrations were also used in the NEAT application in the ADR (UNEP/MAP - MED POL, 2022; 2023).

343. For each measured parameter at each station a contamination ratio (CR) was calculated. Thresholds were the updated sub-regional AEL_BACs (Table 4.3.2.b). CHASE+ methodology in the LEVS was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, aggregation was possible only for TM in sediments and in *M. barbatus*. A contamination score (CS) aggregating 2-3 metals was further calculated. Table 4.3.1.3.b. summarizes the results of the CHASE+ application (UNEP/MAP - MED POL, 2023).

Table 4.3.1.3.b. Number of data points and their percentage from the total number of data points in each category based on the CHASE+ tool, calculated using the new AEL_BACs (UNEP/MAP – MED POL, 2023).

CHASE+		**Blue** **High**	**Green** **Good**	**Yellow** **Moderate**	**Brown** **Poor**	**Red** **Bad**
		NPA or GES		**PA or non-GES**		
Sediment	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
*Cd, Hg, Pb	83	19	38	24	2	0
% from total number of data points		*23*	*46*	*29*	*2*	*0*
		CR=0.0-0.5	**CR=0.5-1.0**	**CR =1.0-2**	**CR =2-5**	**CR>5**
Σ_{16} PAHs	75	45	16	7	3	4
% from total number of data points		*60*	*21*	*10*	*4*	*5*
Σ_5 PAHs	97	75	13	8	1	0
% from total number of data points		*77*	*14*	*8*	*1*	*0*
Σ_7 PCBs	52	18	20	3	4	7

CHASE+		Blue High	Green Good	Yellow Moderate	Brown Poor	Red Bad
		NPA or GES		PA or non-GES		
% from total number of data points		*35*	*38*	*6*	*8*	*13*
M. barbatus	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
Cd, Hg, Pb	15	11	3	0	1	0
% from total number of data points		*73*	*20*	*0*	*7*	*0*

* Without anomalous Cd concentrations for Cyprus

Assessment of Trace metals in sediments of the LEVS

344. Data were reported for all the 3 TMs in 80 stations, while for 3 stations data were reported only for Cd and Pb. However, the concentrations of Cd in Cyprus were much higher than the MedBACs and even higher than the MedEAC agreed upon in Decision IG.23/6 (Table 4.3.1.2.b). Consultation with national representatives and experts of Cyprus provided the explanation that although anomalously high, the concentrations are natural, probably due to specific local minerology. Therefore, Cd concentrations in sediments from Cyprus were excluded from this updated assessment, as in the pilot assessment of the LEVS (UNEP/MED WG.533/6).

345. Out of the 83 stations, 57 (69%) were in-GES (high and good statuses) and 26 (31%) in non-GES classification. Out of the 26 non-GES stations, 24 were classified as in moderate status, with 4 stations borderline to good (green) status (CSs of 1.00-1.01) (Table 4.3.3.b; Figure LEVS 5.2.1.C, Section 5; UNEP/MAP – MED POL, 20238). Two stations were classified as in poor status. It should be mentioned that the moderate status is the least affected status among the 3 PA (corresponding to non-GES) classification. Examination of the CRs for the individual metals found that 21% of the stations were non-GES regarding Cd, 21% of the stations were non-GES regarding Hg and 7% of the stations were non-GES regarding Pb.

346. The non-GES stations were present in all the countries that reported data: Cyprus, Greece, Israel, Lebanon and Türkiye. A detailed examination of the CSs and CRs (Table 4.3.1.3.b; UNEP/MAP – MED POL, 2023) found that stations in moderate status in Cyprus were located in Larnaka Bay, off Zygi and in Chrisochou Bay. Pb concentration in sediments contributed to classification in the moderate status. In Greece, two stations were found in moderate status (Koufonisi (S. Crete), Kastelorizo), with Pb and Cd concentrations contributing to this classification. In Israel, the area classified as moderate status was limited to the northern part of Haifa Bay and concentration of Hg contributed to this classification. The area is known to be still contaminated by legacy Hg, even though there was a vast improvement of the environmental status following pollution abatement measures (Herut et al, 2016, 2021). In Lebanon, the main area in moderate status was off Beirut, in particular the Dora region (with two station in bad status), followed by area in the North Lebanon, with Cd and Hg concentrations contributing equally to the moderate classification. The Beirut area is densely populated and industrialized (Ghosn et al., 2020). In Türkiye, 4 stations were classified as in moderate status: Akkuyu, Taşucu, Anamur, Göksu River mouth. The concentration of Hg contributed to this classification.

Assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments of the LEVS

347. Σ_{16} PAHs in sediments: There were 75 stations with data for Σ_{16} PAHs in sediments reported by Greece, Israel and Lebanon. Out of the 75 stations, 61 (81%) were classified in-GES in high and good statuses and 14 (19%) stations classified as non-GES (Table 4.3.1.3.b; Figure LEVS 5.2.2.C, Section 5; UNEP/MAP - MED POL, 2023). Out of the non-GES stations, 7 stations were classified as moderate, 3 stations as poor and 4 stations as in bad status.

348. Σ_5 PAHs in sediments: There were 97 stations with data for Σ_5 PAHs in sediments, reported by Cyprus, Greece, Israel and Türkiye. Although Σ_5 PAHs is not a mandatory parameter for CI 17, the assessment based on it was performed due to significant more data availability for Σ_5 PAHs compared to Σ_{16} PAHs encompassing a larger assessment area of the LEVS. Therefore, an exception was made in order to increase confidence of the assessment.

Assessment of Σ7 PCBs in sediments and in M. barbatus of the LEVS

349. Data on Σ_7PCBs in sediments were reported only by Lebanon (19 stations) and Türkiye (33 stations). Out of the 52 stations, 38 (73%) were classified in-GES and 14 stations (27%) were classified as non-GES. Out of the non-GES stations, 3 were in moderate status, 4 in poor status and 7 in bad status (Table 4.3.3.b; Figure LEVS 5.2.4.C, Section 5; UNEP/MAP – MED POL, 2023).

350. Data on Σ7PCBs in 12 samples of M, barbatus were reported by Cyprus. All data were bdl,

Assessment of Organochlorinated contaminants other than PCBs in sediments and M. barbatus of the LEVS

351. Sediment. Data for Organochlorinated contaminants other than PCBs were reported only by Türkiye. Dieldrin in all 33 stations were below detection limit (reported as 0 µg/kg dry wt) while data for γ-HCH (Lindane) ranged from below detection limit to 0.14 µg/kg dry wt with both average and median concentrations of 0.05 µg/kg dry wt. The BAC value is not set for Lindane. Only EAC of 3 µg/kg dry wt was adopted by Decision IG.22/7. The concentrations reported for Lindane were well below the EAC value.

352. *M. barbatus*. Cyprus reported concentrations of Dieldrin, Lindane, Hexachlorobenzene, p,p'DDE and Σ_7PCBs in 12 samples of *M. barbatus*. All data, except one data point for Σ_7PCBs were bdl. Lebanon reported 3 data points for total PCBs, with concentrations in the range of 122-306 µg/kg dry wt. No BACs were calculated for these organochlorinated contaminants in *M. barbatus* due to lack of data (UNEP/MAP – MED POL, 2022).

Assessment of Trace metals in M. barbatus of the LEVS

353. TM in *M. barbatus* were available at15 stations from Cyprus, Israel, Lebanon and Türkiye. As explained above, the CHASE+ assessment was performed based on average concentrations calculated for specimens sampled at the same station in different years.

354. Out of 15 stations, 14 (93%) were classified in-GES and 1 (7%) station as non-GES in poor status. The station in poor status was located off Paphos and this classification was due to the concentration of Hg.

4.3.2. The IMAP GES assessment of the Adriatic Sea Sub-region (ADR)

355. Considering the initial discussion on the NEAT tool application during the Regional Meeting on IMAP Implementation: Best Practices, Gaps and Common Challenges (Rome, Italy, 10-12 July 2018), in the context of applying different tools related to GES assessment, NEAT tool application was elaborated (UNEP/MAP – MED POL, 2022; 2023) for GES assessment of IMAP CI 17 in the Adriatic Sea Sub-region in line with the conclusions of this meeting, as well as the Meeting of CorMon on Pollution

Monitoring and the Meeting of the MED POL Focal Points held in 2021 . Specifically, the integration and aggregation rules were elaborated in the context of the NEAT tool application for GES assessment of IMAP CI 17 in the Adriatic Sea Sub-region, including optimal temporal and spatial integration and aggregation of the assessment findings within nested approach agreed for IMAP implementation. The GES was assessed by applying the NEAT tool on the Adriatic nested scheme. The Contaminants' data were aggregated and integrated per habitat (sediments, mussels) while the various levels of spatial integration (nesting) are provided to ensure scaling of the assessment findings i.e., the assessment findings integration to the level that is considered meaningful for Common Indicator 17. The NEAT IMAP GES Assessment methodology was applied on the spatial scope of the finest areas of assessment and the areas of assessment nested to the levels of integration that are considered meaningful (UNEP/MAP – MED POL, 2022; 2023).

Available data

356. Data on contaminants (Cd, Hg, Pb, PAHs and PCBs) have been collected from all Contracting Parties bordering the Adriatic Sea for the years 2015 to 2021, except from Bosnia and Herzegovina[37] that does not monitor contaminants in marine environment. Details on the temporal and spatial availability of data per IMAP SAUs, per environmental matrix (sediments, biota) and per contaminants group (trace metals (TM), PAHs, PCBs) are provided here-below in Table 4.3.2.1 and elaborated in Table I in Annex VIII (CH 4.3.2). The spatiotemporal coverage varies largely among the various IMAP SAUs. Sediments stations have in general higher spatial coverage. For some IMAP SAUs data are not existent or correspond to only 1 or 2 stations sampled once. Trace metals in sediments are monitored in the highest number of stations (205) and all SAUs have at least one station sampled once, followed by PAHs stations (125) and PCBs (59). The Central Adriatic subdivision is the least monitored for PAHs in sediments while it is not at all monitored for PCBs in sediments. All monitoring stations for biota refer to samplings of the mussel species, *Mytilus galloprovincialis*, therefore no data on organic compounds are available for fish matrix. Regarding the spatial coverage of monitoring stations for biota this is by far lower than that in sediments. Trace metals are monitored in 64 stations, PAHs in 29 and PCBs in 38. Contaminants' data in fish were scarce, reported only for trace metals in 27 stations in Croatian waters and 4 stations in Montenegrin waters. In addition, not always the same fish species was sampled making comparisons and harmonized assessment difficult.

357. As explained above in Section 2, a set of criteria was applied to propose the scope of the areas of monitoring. To better understand differences in the spatial coverage of the SAUs the ratio of number of stations to surface of the area (no of stations/km^2) is calculated as shown in Table I in Annex VIII (CH 4.3.2). This ratio was calculated to support application of the criteria related to representativeness of the areas of monitoring for establishing areas of assessment. It is understood that the highest the ratio, the better the spatial coverage. However, in areas with limited presence of pressures a low ratio may be equally suitable for the purposes of a sound assessment. For this reason, the calculated ratios are only indicative and comparisons among them should be made keeping in mind the specific features of the SAUs. On the Adriatic sub-division level, the North Adriatic Sea is better covered by monitoring stations. Further to this criterion, the spatial distribution of monitoring stations and its comparison with the sufficiency of quality-assured data as collated for NEAT application were analyzed. Table II in Annex VIII (CH 4.3.2) provides the spatial coverage of monitoring data collected per each SAU in the Adriatic Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately. Table 4.3.2.1. and Table III in Annex VIII (CH 4.3.2) provide the temporal coverage of monitoring data used again per each SAU in the Adriatic Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately.

[37] Bosnia and Herzegovina has not been included in the present GES assessment due to lack of data on contaminants, however IMAP SAUs were set for this CP (UNEP/MAP – MED POL 2022; 2023)

Table 4.3.2.1. Data available for the environmental assessment of the Adriatic Sea (ADR) Sub-region.

Source	IMAP-File	Country	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin	Hexachlorobenzene	p.p' DDE
Sediment													
IMAP_IS		Albania	2020	6	6	6		6					
IMAP_IS	520	Croatia	2017	37	37	37							
IMAP_IS	520	Croatia	2019	30	30	30							
		Greece	2018	1		1	1						
IMAP_IS	457	Italy	2016	42	42	42	23	38	38	52		52	
IMAP_IS	457	Italy	2017	40	40	40	14	30	22	41		41	
IMAP_IS	457	Italy	2018	24	24	24	14	17	16	30		30	
IMAP_IS	457	Italy	2019	11		26				26		10	
EMODNet		Italy	2015	30	30	30							
EMODNet		Italy	2016	90	72	97							
EMODNet		Italy	2017	74	61	80							
MED POL		Montenegro	2016	5	5	5							
MED POL		Montenegro	2017	15	15	15							
MED POL		Montenegro	2018	6	6	6	6						
IMAP_IS		Montenegro	2019	29	29	29	29	29	29	12	29	29	29
IMAP_IS		Montenegro	2020	12	12	12	12	12	12	12	12	12	12
IMAP_IS		Montenegro	2021	19	19	19							
MED POL		Slovenia	2018				1	1					
IMAP_IS	204,657	Slovenia	2019	5	5	5	5	5	5	5	5	5	5
M. galloprovincialis													
IMAP_IS	520	Croatia	2019	19	19	19			19				
IMAP_IS	520	Croatia	2020	18	16	18							
IMAP_IS	460	Italy	2016	8	15	8		4		8		15	
IMAP_IS	460	Italy	2017	10	18	10		11		10		18	
IMAP_IS	460	Italy	2018	8	19	8		8		12		16	
IMAP_IS	460	Italy	2019		7							7	
EMODNet		Italy	2015		6								
EMODNet		Italy	2016		15								
EMODNet		Italy	2017		19								
EMODNet		Italy	2018		2								
MED POL		Montenegro	2018	8	8	8	8						

Source	IMAP-File	Country	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin	Hexachlorobenzene	p.p' DDE
IMAP_IS		Montenegro	2019	10	10	10	11	11	11				
IMAP_IS		Montenegro	2020	10	10	10	10	10	10				
MED POL		Slovenia	2017	3	3	3							
IMAP_IS		Slovenia	2018	3	3	3							
IMAP_IS	204,657	Slovenia	2019	3	3	3	3	3					
IMAP_IS	439,658	Slovenia	2020	3	3	3	3	3					
IMAP_IS	656	Slovenia	2021	3	3	3		3					
M. barbatus													
IMAP_IS	520	Croatia	2019	1		1							
IMAP_IS	520	Croatia	2020	2	2	2							
IMAP_IS	520	Croatia	2020	8	8	8							
MED POL		Montenegro	2018	8	8	8							

358. For the application of the NEAT software, data on contaminants were grouped per parameters, ecosystem components (i.e. for the purpose of present NEAT application these are considered biota and sediment matrixes) and SAUs in all the Adriatic sub-divisions (NAS, CAS, SAS). Average concentrations (arithmetic means) and their respective standard errors were then calculated in the respective groups as follows:

Arithmetic mean concentration: $\bar{C} = \frac{\sum_{i=1}^{n} C_i}{n}$,

Standard Deviation: $SD = \sqrt{\frac{\sum_{i=1}^{n}(C_i - \bar{C})^2}{n-1}}$,

Standard Error : $SE = \frac{SD}{\sqrt{n}}$

where, $\bar{C}$ is the average (arithmetic mean) concentration for each SAU, C_i is the individual contaminant concentration measured in each station/date in the SAU, and n is the total number of concentration records for each SAU; SD is the sample standard deviation for a specific contaminant and SAU and SE is the standard error for a specific contaminant and SAU.

359. Several records on PAHs and PCBs individual compounds were reported as below detection limit values (DL) or were left blank. In a separate technical paper, prepared by MED POL in consultations with OWG EO9, it was recommended to incorporate into the BC and BAC calculations of the BDL values and not to exclude them[38.] For the present application of NEAT these cases were substituted by the BDL/2 value, given a rather small quantum of data available, this does not influence the calculation of the

[38] In a separate technical paper, prepared by MEDPOL in consultations with OWG on Contaminants, it was suggested to 'replace BDL values with a fraction of the reported value. The fraction could be 1 (BDL value), 0.5 (BDL/2), 0.7 (BDL/SQRT(2)), other' and not exclude BDL values from BC calculation. The decision to replace BDL with the reported value or a fraction of it should be based on the available data and expert evaluation. Italy, Spain and France supported the use of LOD/2 or LOQ/2 in the BCs calculation. Israel pointed out that the US- EPA suggests this only when less than 15% of the data is BDLs. Therefore, the calculation for the assessment criteria was performed with the reported value and not half of it (UNEP/MAP - MED POL 2022). This is because the wide range of BDL values for a specific contaminant in a specific matrix, depending on the country and it varies even within the country.

assessment findings. In the Slovenian data, the BDL values were left blank so these were substituted by a value equal to 1μg/kg which corresponds to the average BDL/2 value from the whole data set. Furthermore, due to this fact, but also considering the list of substances the monitoring of which is mandatory according to IMAP[39], the sum of the 16 EPA compounds (Σ_{16}PAHs) and sum of the 7 PCBs compounds (Σ_7PCBs) was taken into account for the present assessment. In this way the assessment results show the cumulative impact by each of these two groups of contaminants.

360. A detailed data matrix was prepared and used for the NEAT software application (UNEP/MAP - MED POL, 2023).

The integration of the areas of assessment and assessment results by applying the 4 levels nesting approach

361. Following the rules of integration of assessments within the nested approach, for the assessment of EO9 Common Indicators, the coastal monitoring zone is equal to the respective assessment zone as defined for the purposes of the present work (UNEP/MAP-MED POL, 2022; 2023). For the offshore zone, monitoring areas may be representative of broader assessment areas beyond territorial waters and in these cases the offshore monitoring areas are not necessarily equal to the offshore assessment areas. The stations positioned within the offshore zone are considered representative of a wider offshore area, as officially declared by the countries.

362. In the absence of declared areas of monitoring by all the concerned CPs, following the rationale of the IMAP national monitoring programmes and distribution of the monitoring stations, as well as the methodology approved by the Meetings of CorMon Pollution held in 2021 and 2022 (UNEP/MAP - MED POL 2021; 2022), the two zones of areas of monitoring are defined for the purposes of the present work: i) the coastal zone and ii) the offshore zone.

363. Detailed explanation on the data sources used and methodology followed for setting of the two zones (coastal and offshore) is provided for the purpose of the present work(UNEP/MAP - MED POL, 2023). In summary, GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase) by the MEDCIS project were used for the present work for Slovenia, Croatia and Italy; for Albania, Montenegro and Greece these data were not accurate or do not include the relevant information and therefore were replaced/corrected in line with relevant national sources i.e. results of GEF Adriatic Project and provisions of relevant national legal acts. The MEDCIS work takes into consideration the existence of bays and inlets which are numerous in particular in the east part of the Adriatic Sea and calculates the baseline using the straight baseline method by joining appropriate points.

364. For IMAP CI 17, integration of assessments up to the subdivision level is considered meaningful. Therefore, the three main subdivisions of the Adriatic Sea, namely, North, Central and South Adriatic (NAS, CAS, SAS) have been chosen following the specific geomorphological features as available in relevant scientific sources (e.g. bottom depths and slope areas, existence of deep depression, salinity and temperature gradient, water mass exchanges) (Cushman-Roisin et al., 2001). The coverage of the 3 sub-divisions is shown in Figure 4.3.2.1.

[39] According to IMAP i.e. IMAP Guidance Fact Sheet and Data Dictionaries for IMAP CI 17, monitoring of the sum of 7 PCB congeners: 28, 52,101,118,138,153 and 180 and sum of 16 US EPA PAHs is considered mandatory.

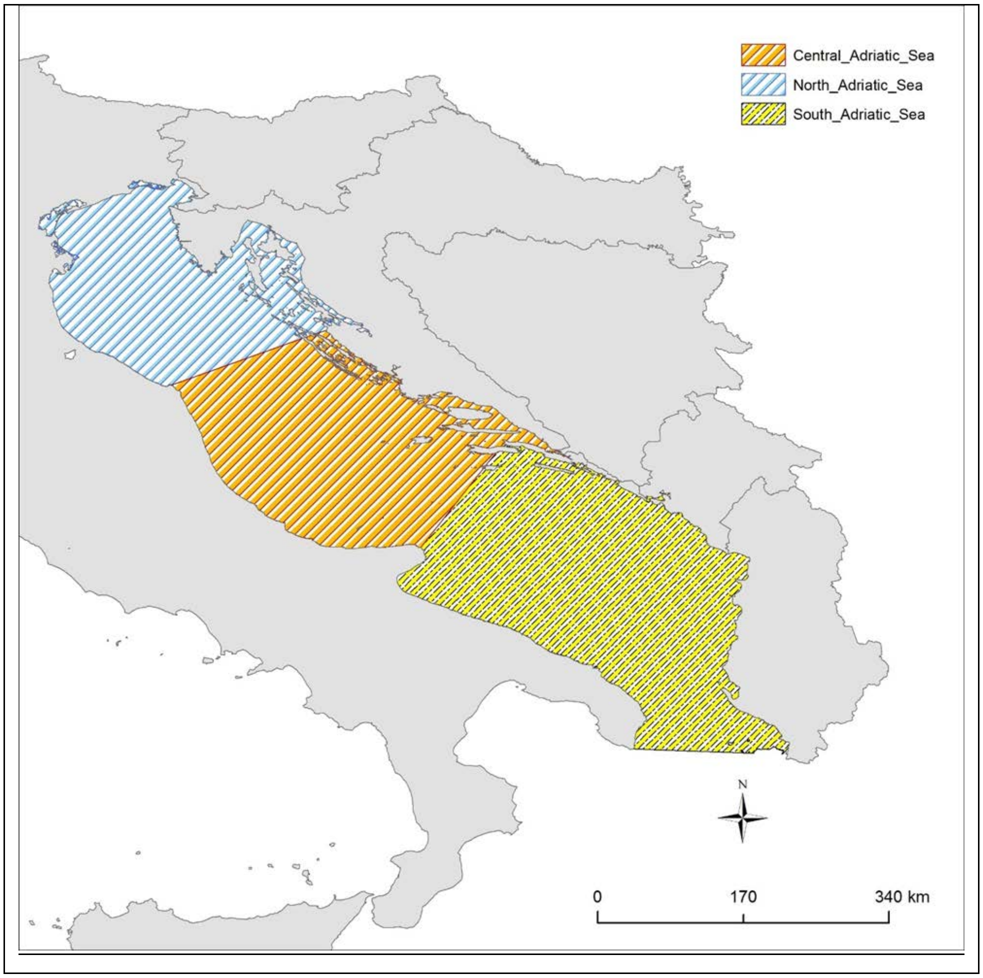


Figure 4.3.2.1. The 3 subdivisions of the Adriatic subregion defined based on Cushman-Roisin et al. (2001).

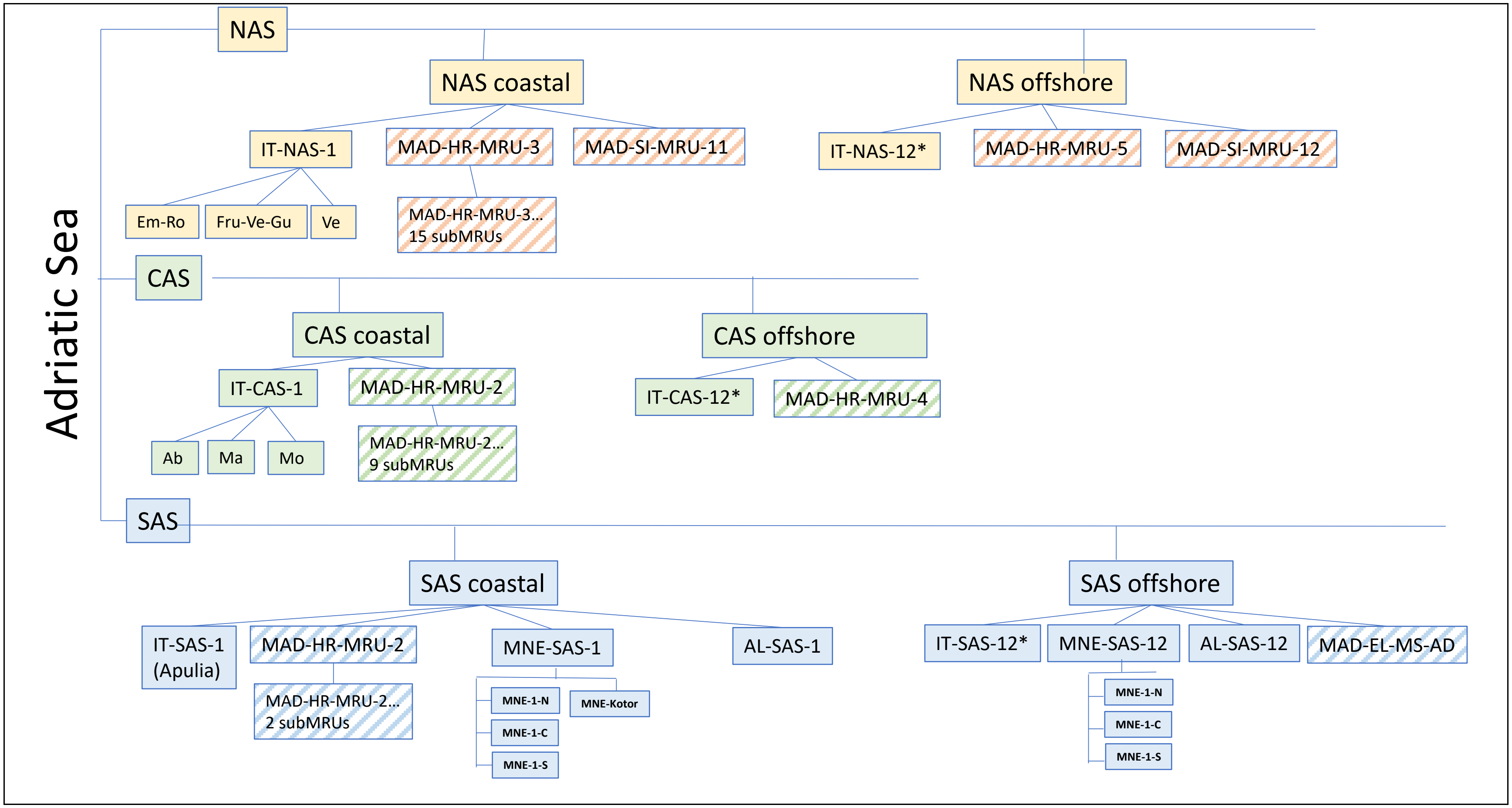
365. The four following steps for integration of the areas of assessment was followed to accomplish the objectives of the NEAT IMAP GES Assessment (detailed elaboration provided in UNEP/MED WG.556/In.16):

- Step 1 “Defining coastal and offshore waters”;
- Step 2 “Recognizing scope of IMAP areas of monitoring”;
- Step 3 “Setting IMAP area of assessment”:
- Step 4 “Nesting of the areas of assessment within application of NEAT tool” by applying the 4 levels nesting scheme where 1st level is the finest and 4th level is the highest:
  - 1st level provided nesting of all national IMAP SAUs & sub-SAUs within the two key IMAP assessment zones per country, i.e. coastal and offshore zones;
  - 2nd level provided nesting of the assessment areas set in the key IMAP assessment zones i.e. coastal and offshore zones, on the sub-division level i.e. i) NAS coastal, NAS offshore; ii) CAS coastal, CAS offshore; iii) SAS coastal, SAS offshore);
  - 3rd level provided nesting of the areas of assessment within the 3 sub-divisions (NAS, CAS, SAS);
  - 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub-region

366. Similarly, the integration of the assessment results is conducted following the 4 levels nesting approach:

- 1st level: Detailed assessment results provided per sub-SAUs and SAUs;
- 2nd level: Integrated assessment results provided per i) NAS coastal (NAS-1), NAS offshore (NAS-12); ii) CAS coastal (CAS-1), CAS offshore (CAS-12); iii) SAS coastal (SAS-1), SAS offshore (SAS-12);
- 3rd level: Integrated assessment results provided per subdivision NAS, CAS, SAS;
- 4th level: Integrated assessment results provided for the Adriatic Sea Sub-region.

The graphical depiction of this nesting scheme is shown in Figure 4.3.2.2 (UNEP/MAP – MED POL, 2023).



*For Italy the offshore IMAP SAUs areas (IT-NAS-O, IT-CAS-O, IT-SAS-O) is calculated by subtracting the surface of area of the coastal zone from the surface area of the 3 official MRUs (IT-NAS-0001, IT-CAS-0001, IT-SAS-0001).

Figure 4.3.2.2: The nesting scheme of the SAUs defined for the Adriatic Sea based on the available information. Shaded boxes correspond to official MRUs declared by the countries that are EU MSs and that were decided to be used as IMAP SAUs.

367. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, as described in Section 2 (UNEP/MAP – MED POL, 2022; 2023), the scope of all Adriatic SAUs and subSAUS were defined. All of them were introduced in the NEAT tool along with their respective codes and surface area (km^2).

368. Within each SAU under 'habitats' the sediments and biota are introduced. Under 'ecosystem component' the 5 chemical compounds of EO9/CI17 are assigned. For each SAU and 'Ecological Component' (EO9 contaminants in our case) and 'Habitat' (sediments, biota), average value and standard deviation per chemical compound is inserted.

369. The use of NEAT tool requires two boundary limit values for the best and worse conditions (these are not threshold values but the minimum and maximum values that determine the scale of the assessment) and one threshold value for the GES – nonGEs status. For the present analysis, the two boundary limit values are: i) zero contaminant concentration for the best conditions; ii) the maximum concentration of contaminants used for the present analysis for the worse conditions

370. These are mandatory by the tool which then produces five status classes linearly, depending on the distance of the concentrations from the two boundary limit values and the GES-nonGES threshold. However, the user may also assign threshold values for all other status classes as appropriate. A 5-class assessment scale 'High-Good-Moderate-Poor-Bad' is then produced (Table 2.5.2.a. in Section 2, and Table 4.3.2.2 here-below).

Setting the GES/non GES boundary value/threshold

371. Upgrading of the baselines and threshold values for IMAP CI 17 in the Mediterranean Sea is an ongoing process. The present assessment analysis applying the NEAT tool was conducted for each subdivision using the assessment criteria for the GES-nonGES threshold, based on BAC values shown in Table 4.3.2.2, as approved by the Meeting of CorMon Pollution Monitoring (27 and 30 May 2022) (UNEP/MAP MED – MED POL, 2022) and following the recommendations related to the Tyrrhenian Sea as provided by the Meeting of the SIDA funded Project "Toward integration ecosystem assessment and ecosystems management approach in the Adriatic Sea Sub-region" (10 November 2022, Tunisia).

Table 4.3.2.2.: The BAC values calculated for the Adriatic Sea and used for the present assessment

	Adriatic BAC (µg/kg dry wt)	
	Sediments	**Biota (MG)**
Cd	180	944
Hg	75	113
Pb	23550	1500
$^{*}\Sigma_{16}$ PAHs	61.5	9.9
$^{+}\Sigma_{7}$ PCBs	0.21	17.3

372. The final marine environment quality status assessment regarding CI17 in the Mediterranean Sea provides in a consolidated manner the individual assessments for each of the sub-regions and/or sub-divisions. Therefore, all individual assessments were harmonized to the extent possible in order to ensure the compatibility of the assessments, as explained above in Section 2.5.3 (UNEP/MAP – MED POL, 2023).

373. In line with an updated assessment classification for a harmonized application of NEAT and CHASE+ tools in the four Mediterannean Sea sub-regions (Table 2.5.2.a. in Section 2), the Boundary limits of the 5-class assessment scale and class Threshold values were applied for NEAT GES Assessment of the Adriatic Sea-Sub-region (Table 4.3.2.3).

Table 4.3.2.3: Boundary limits of the assessment scale and class Threshold values used for the application of the NEAT tool for IMAP.

	Low Boundary limit	**Threshold** High/Good	**Threshold** Good/Moderate	**Threshold** Moderate/poor	**Threshold** Poor/Bad	**Upper Boundary Limit**
Sediments	**(µg/kg)**	**0.5 (xBAC) (µg/kg)**	**xBAC (µg/kg)**	**2(x BAC) (µg/kg)**	**5(xBAC)**	**Max. conc. (µg/kg)**
Cd	0	135	270	540	1350	9000
Hg	0	56.5	113	225	563	14200
Pb	0	17662	35325	70650	176625	356000
*Σ_{16} PAHs	0	61.5	123	246	615	26649
+Σ_7 PCBs	0	0.21	0.42	0.8	2.1	434
Biota (*M. galloprovincialis*)						
Cd	0	708	1416	2832	7080	9000
Hg	0	85	170	339	848	10000
Pb	0	1125	2250	4500	11250	167884
+Σ_7 PCBs	0	17.3	34.6	69	173	180

*sum of the individual BACs or xBACs values of the 16 PAH compounds
+ sum of the individual BACs or xBACs values of the 7 PCB compounds

374. The data (i.e. average values inserted), as well as boundary limits and threshold values are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and to facilitate aggregation on the CI or EO level.

375. Threshold concentrations are normalized in a 0 to 1 scale as follows:

$0 \leq \text{bad} < 0.2 \leq \text{poor} < 0.4 \leq \text{moderate} < 0.6 \leq \text{good} < 0.8 \leq \text{high} \leq 1$

376. NEAT aggregates data by calculating the average of normalized values of contaminants (Cd, Pb, PAHs, etc.) on the SAU level. This can be done either per each contaminant per habitat (i.e., sediments, biota) separately or for all contaminants per habitats (i.e. sediments, biota) within specific SAU. The first option leads to one value for each chemical compound separately for a specific SAU.

377. The process is then repeated for all nested SAUs (in a weighted or non- weighted mode) for all ecosystem components - contaminants separately, or for all ecosystem components by habitat (sediments, biota). In the weighted mode a weighting factor based on the surface area of each SAU is used.

378. The NEAT values are values between 0 to 1 and correspond to an overall assessment status per contaminant according to the 5-class scale.

379. The decision rule of GES/ non-GES is by comparison to the boundary class defined by the (xBAC) and this is above/ below Good (0.6).

Results of the IMAP NEAT GES Assessment of CIs 17 in the Adriatic Sea Sub-region

380. The results obtained from the NEAT tool are shown below in Tables 4.3.2.4.a and 4.3.2.4.b. Table 4.3.2.4.a provides detailed assessment results on the EO9/CI 17 level per contaminant and also spatially integrated within the nested scheme at i) the IMAP national SAUs & subSAUs, as the finest level; ii) the IMAP coastal and offshore assessment zones of sub-divisions (NAS Coastal, NAS Offshore, CAS Coastal, CAS Offshore, SAS Coastal, SAS Offshore); iii) the sub-division level (NAS, CAS, SAS) and iv) the sub-regional level (Adriatic Sea).

381. At the same time aggregation of all contaminants data is done in order to obtain one chemical status value (NEAT value) for all the levels of the nesting scheme. In other words the data matrix in Table 4.3.2.4.b shows the results per contaminant per habitat per SAU in the finest level which are i) integrated along the nesting scheme (in columns A - I bold lines); and ii) are aggregated for all contaminants and habitats per SAU (in rows) leading to one NEAT value per SAU (column EO9). The latter is further integrated along the nesting scheme (column EO9 bold lines).

382. The NEAT tool has the possibility also to provide assessment results by aggregating data per habitat in this case sediments and biota (mussels) and then spatially integrated within the nested scheme. The final integrated result per SAU (NEAT value) is the same for the two ways of assessment (i.e. per contaminants (Table 4.3.2.4.a) or per habitats (Table 4.3.2.4.b) as expected.

383. The Tabulated NEAT results of Tables 4.3.2.4.a and 4.3.2.4.b (schematic presentation, UNEP/MAP MED POL, 2023). .

384. The detailed status assessment results per contaminant per SAU at the 1st level of assessment (no aggregation or integration) show that in most cases GES conditions are achieved (High, Good status) i.e., for 80% of SAUs, which are indicated by the blue and green cells in Table 4.3.2.4.a; 9% are classified under the moderate status, 6% under the poor and 5% under the bad. For the sediment matrix, the highest contamination is observed from PCBs, PAHs and Hg resulting in non-GES status for 60%, 57% and 27 % of sub-SAUs respectively. For the mussels matrix, the highest contamination is observed from PCBs which results in 39% of sub-SAUs in non-GES status. In the NAS, 19% of sub-SAUs are classified as non-GES, in the CAS 12% are classified as non-GES, while in the SAS 22 % are classified as non-GEs. The most affected sub-SAUs in the NAS are HRO-0313-BAZ, HRO-0412-PULP and HRO-0423-RILP in Croatia; Emiglia-Romana', 'Fruili-Venezia-Giulia-1' and 'Veneto-1' in Italy. Also, offshore SAUs IT-NAS-O and MAD-Sl-MRU-12. In the CAS, most affected sub-SAUs are HRO-0313-KASP, HRO-0313-KZ, HRO-0423-KOR in Croatia. In the SAS, affected SAUs are HRO-0313-ZUC, HRO-0423-MOP and HRO-0313-ZUC in Croatia; and MNE-1-N, MNE-1-C, MNE-1-S, MNE-Kotor, in Montenegro which are found in poor or bad conditions regarding several contaminants.

385. Overall, it can be seen from Tables 4.3.2.4.a and 4.3.2.4. b that TM in sediments have the largest spatial coverage with 49 out of 49 SAUs covered. For the other compounds and 'habitats' (sediments, mussels) several SAUs totally lack of data. In these cases, the integrated assessment result on the sub-division level (NAS, CAS, SAS) is based on only a few SAUs and cannot be considered representative. This is true for the assessment of Σ_{16}PAHs in sediments which is based on 14 out 49 SAUs and data delivered by from Italy, Slovenia, Montenegro; Σ_7PCBs in sediments which is based on 10 out of 49 SAUs and data delivered by Italy and Montenegro. In addition, Σ_7PCBs data in sediments for the CAS are non-existent. For the mussels, TM have the largest coverage and are measured in 28 out of the 49 SAUs, based on data delivered by Croatia, Italy, Slovenia and Montenegro (only in the coastal SAUs). Σ_7PCBs

in mussels are measured in 22 out of 49 SAUs based on data delivered by Croatia and Montenegro, however most of the SAUs have been sampled only once.

Table 4.3.2.4.a. Status assessment results of the NEAT tool applied on the Adriatic nesting scheme for the assessment of EO9/CI17. The various levels of spatial integration (nesting) are marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis (UNEP/MAP – MED POL, 2023).

			EO9			**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
SAU	**Area (km^2)**	**SAU weight factor**	**NEAT value**	**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
Adriatic Sea	**139783**	**0**	**0.738**	**good**	**88**	**0.841**	**0.807**	**0.878**	**0.786**	**0.346**	**0.821**	**0.421**	**0.748**	**0.631**
Northern Adriatic Sea	**31856**	**0**	**0.592**	**moderate**	**84**	**0.842**	**0.466**	**0.827**	**0.733**	**0.236**	**0.835**	**0.47**	**0.842**	**0.743**
NAS coastal	**9069**	**0**	**0.774**	**good**	**100**	**0.838**	**0.739**	**0.814**	**0.4**	**0.199**	**0.834**	**0.809**	**0.842**	**0.743**
MAD-HR-MRU-3	6422	0	0.829	high	100	0.891	0.887	0.833			0.811	0.813	0.818	0.696
HRO-0313-JVE	73	0.001	0.726	good	100	0.853	0.872	0.711			0.754	0.574	0.709	0.522
HRO-0313-BAZ	4	0	0.51	moderate	100	0.684	0.333	0.513						
HRO-0412-PULP	7	0	0.477	moderate	100	0.803	0.166	0.462						
HRO-0412-ZOI	473	0.003	0.864	high	100	0.894	0.861	0.874			0.89	0.857	0.859	0.803
HRO-0413-LIK	7	0	0.791	good	86	0.886	0.763	0.623			0.846	0.809	0.85	0.792
HRO-0413-PAG	30	0	0.796	good	69	0.832	0.837	0.761			0.84	0.853	0.814	0.618
HRO-0413-RAZ	10	0	0.825	high	100	0.852	0.883	0.741						
HRO-0422-KVV	494	0.004	0.798	good	57	0.867	0.915	0.849			0.806	0.709	0.768	0.598
HRO-0422-SJI	1923	0.014	0.859	high	100	0.916	0.944	0.906			0.825	0.855	0.816	0.688
HRO-0423-KVA	686	0.005	0.849	high	100	0.879	0.893	0.817			0.847	0.85	0.862	0.78

			EO9			**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
SAU	**Area (km^2)**	**SAU weight factor**	**NEAT value**	**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
HRO-0423-KVJ	1089	0.008	0.826	high	97	0.888	0.907	0.791			0.752	0.835	0.992	0.734
HRO-0423-KVS	577	0.004	0.797	good	72	0.903	0.853	0.847			0.831	0.789	0.704	0.58
HRO-0423-RILP	6	0	0.538	moderate	100	0.398	0.626	0.589						
HRO-0423-RIZ	475	0.003	0.766	good	89	0.877	0.861	0.728			0.758	0.677	0.669	0.734
HRO-0423-VIK	455	0.003	0.783	good	71	0.869	0.7	0.737			0.785	0.811	0.721	0.873
IT-NAS-C	2592	0	0.638	good	100	0.703	0.49	0.761	0.398	0.199	0.925	0.917	0.938	0.908
IT-Em-Ro-1	371	0.003	0.587	moderate	71	0.801	0.647	0.869	0.416	0.199				
IT-Fr-Ve-Gi-1	575	0.004	0.543	moderate	100	0.843	0.159	0.627						
IT-Ve-1	1646	0.012	0.684	good	100	0.495	0.63	0.87	0.39	0.199	0.925	0.917	0.938	0.908
MAD-SI-MRU-11	55	0	0.752	good	100	0.886	0.351	0.975	0.446		0.87	0.453	0.881	
NAS offshore	**22788**	**0**	**0.52**	**moderate**	**100**	**0.845**	**0.262**	**0.835**	**0.769**	**0.24**	**0.869**	**0.446**	**0.833**	
MAD-HR-MRU-5	5571	0			0									
IT-NAS-O	10540	0.161	0.519	moderate	100	0.844	0.263	0.84	0.775	0.24		0.445		
MAD-SI-MRU-12	129	0.002	0.634	good	0	0.889	0.188	0.574	0.375		0.869	0.582	0.833	
Central Adriatic	**63696**	**0**	**0.728**	**good**	**80**	**0.82**	**0.852**	**0.892**	**0.938**		**0.84**	**0.336**	**0.752**	**0.513**

			EO9			A	B	C	D	E	F	G	H	I
SAU	**Area (km²)**	**SAU weight factor**	**NEAT value**	**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
CAS coastal	**9394**	**0**	**0.833**	**high**	**100**	**0.831**	**0.868**	**0.874**	**0.938**		**0.84**	**0.823**	**0.752**	**0.513**
MAD-HR-MRU-2	7302	0	0.83	high	100	0.854	0.894	0.845			0.84	0.823	0.752	0.513
HRO-0313-NEK	253	0.003	0.803	high	67	0.784	0.824	0.689			0.858	0.865	0.883	0.757
HRO-0313-KASP	44	0	0.595	moderate	55	0.724	0.266	0.686			0.875	0.691	0.762	0.2
HRO-0313-KZ	34	0	0.639	good	100	0.816	0.291	0.81						
HRO-0313-MMZ	55	0.001	0.805	high	60	0.837	0.896	0.788			0.828	0.816	0.755	0.676
HRO-0413-PZK	196	0.002	0.733	good	97	0.887	0.737	0.766			0.844	0.842	0.584	0.406
HRO-0413-STLP	1	0	0.644	good	100	0.778	0.335	0.82						
HRO-0423-BSK	613	0.006	0.788	good	76	0.8	0.705	0.792			0.81	0.819	0.804	0.803
HRO-0423-KOR	1564	0.016	0.791	good	85	0.886	0.893	0.888			0.848	0.819	0.731	0.377
HRO-0423-MOP	2480	0.025	0.883	high	100	0.854	0.941	0.852						
IT-CAS-C	2092	0	0.845	high	100	0.779	0.742	0.94	0.938					
IT-Ab-1	282	0.005	0.886	high	100	0.809	0.867	0.932	0.938					
IT-Ma-1	319	0.006	0.836	high	100	0.724		0.947						
IT-Mo-1	229	0.004	0.808	high	61	0.864	0.626	0.934						
CAS offshore	**54303**	**0**	**0.71**	**good**	**80**	**0.817**	**0.85**	**0.896**	**0.925**			**0.32**		
MAD-HR-MRU-4	18963	0.178	0.897	high	100	0.887	0.909	0.894						

			EO9			A	B	C	D	E	F	G	H	I
SAU	**Area (km²)**	**SAU weight factor**	**NEAT value**	**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
IT-CAS-O	22393	0.21	0.551	moderate	69	0.7	0.749	0.899	0.925			0.32		
Southern Adriatic Sea	**44231**	**0**	**0.858**	**high**	**100**	**0.868**	**0.859**	**0.877**	**0.853**	**0.795**	**0.778**	**0.883**	**0.573**	**0.548**
SAS coastal	**7276**	**0**	**0.769**	**good**	**99**	**0.837**	**0.793**	**0.797**	**0.204**	**0.348**	**0.778**	**0.883**	**0.573**	**0.548**
MAD-HR-MRU-2	4252	0	0.73	good	100	0.843	0.877	0.733			0.777	0.745	0.583	0.516
HRO-0313-ZUC	13	0	0.792	good	68	0.843	0.888	0.903			0.769	0.841	0.724	0.487
HRO-0423-MOP	1756	0.031	0.73	good	100		0.877	0.732			0.777	0.744	0.582	0.516
IT-SAS-C (Ap-1)	1810	0.013	0.931	high	100	0.804	0.944	0.943				0.965		
MNE-SAS-C	483	0	0.618	good	99	0.7	0.665	0.667	0.204	0.348	0.791	0.871	0.47	0.884
MNE-1-N	86	0.001	0.7	good	81	0.813	0.928	0.932	0.198	0.629				
MNE-1-C	246	0.002	0.494	moderate	92	0.52	0.525	0.396	0.237	0.2	0.648	0.816	0.15	0.838
MNE-1-S	151	0.001	0.812	high	94	0.852	0.867	0.931	0.182	0.383	0.986	0.973	0.978	0.986
MNE-Kotor	85	0.001	0.546	moderate	99	0.722	0.183	0.446	0.164	0.15	0.858	0.848	0.492	0.838
AL-SAS-C	646	0.005	0.686	good	95	0.917	0.199	0.943						
SAS offshore	**36955**	**0**	**0.875**	**high**	**100**	**0.87**	**0.869**	**0.888**	**0.876**	**0.841**				
IT-SAS-O	22715	0.216	0.876	high	100	0.861	0.877	0.891						

			EO9			A	B	C	D	E	F	G	H	I
SAU	**Area (km²)**	**SAU weight factor**	**NEAT value**	**Status class**	**% Confidence**	**CI17_Cd seds**	**CI17_Hg seds**	**CI17_Pb seds**	**Σ16 PAHs seds**	**Σ7 PCBs seds**	**CI17_Cd mus**	**CI17_Hg mus**	**CI17_Pb mus**	**Σ7 PCBs mus**
MNE-SAS-O	2076	0	0.882	high	100	0.91	0.924	0.83	0.905	0.841				
MNE-12-N	513	0.005	0.869	high	100	0.927	0.928	0.845	0.863	0.781				
MNE-12-C	713	0.007	0.891	high	100	0.886	0.941	0.809	0.941	0.876				
MNE-12-S	849	0.008	0.883	high	100	0.92	0.907	0.839	0.899	0.848				
AL-SAS-O	716	0.007	0.78	good	61	0.924	0.5	0.915						
MAD-EL-MS-AD	2253	0.021	0.886	high	100	0.914		0.884	0.86					

Table 4.3.2.4.b.: Status assessment results of the NEAT tool applied on the Adriatic nested scheme for the assessment of EO9/CI 17. Contaminants' data are aggregated and integrated per habitat (sediments, mussels). The various levels of spatial integration (nesting) are marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis (UNEP/MAP - MED POL 2023).

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
Adriatic Sea	**139783**	**0**	**0.738**	**good**	**88**	**0.825**	**0.48**
Northern Adriatic Sea	**31856**	**0**	**0.592**	**moderate**	**84**	**0.637**	**0.545**
NAS coastal	**9069**	**0**	**0.774**	**good**	**100**	**0.741**	**0.814**
MAD-HR-MRU-3	6422	0	0.829	high	100	0.87	0.787
HRO-0313-JVE	73	0.001	0.726	good	100	0.812	0.64
HRO-0313-BAZ	4	0	0.51	moderate	100	0.51	
HRO-0412-PULP	7	0	0.477	moderate	100	0.477	
HRO-0412-ZOI	473	0.003	0.864	high	100	0.877	0.852
HRO-0413-LIK	7	0	0.791	good	86	0.757	0.824
HRO-0413-PAG	30	0	0.796	good	69	0.81	0.781
HRO-0413-RAZ	10	0	0.825	high	100	0.825	
HRO-0422-KVV	494	0.004	0.798	good	57	0.877	0.72
HRO-0422-SJI	1923	0.014	0.859	high	100	0.922	0.796
HRO-0423-KVA	686	0.005	0.849	high	100	0.863	0.835
HRO-0423-KVJ	1089	0.008	0.846	high	97	0.862	0.828
HRO-0423-KVS	577	0.004	0.797	good	72	0.868	0.726
HRO-0423-RILP	6	0	0.538	moderate	100	0.538	

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
HRO-0423-RIZ	475	0.003	0.766	good	89	0.822	0.709
HRO-0423-VIK	455	0.003	0.783	good	71	0.769	0.797
IT-NAS-C	2592	0	0.638	good	100	0.507	0.922
IT-Em-Ro-1	371	0.003	0.587	moderate	71	0.587	
IT-Fr-Ve-Gi-1	575	0.004	0.543	moderate	100	0.543	
IT-Ve-1	1646	0.012	0.684	good	100	0.445	0.922
MAD-SI-MRU-11	55	0	0.7	good	100	0.664	0.735
NAS offshore	**22788**	**0**	**0.52**	**moderate**	**100**	**0.591**	**0.449**
MAD-HR-MRU-5	5571	0			0		
IT-NAS-O	10540	0.161	0.519	moderate	100	0.592	0.445
MAD-SI-MRU-12	129	0.002	0.634	good	0	0.506	0.761
Central Adriatic	**63696**	**0**	**0.728**	**good**	**80**	**0.855**	**0.367**
CAS coastal	**9394**	**0**	**0.833**	**high**	**100**	**0.859**	**0.732**
MAD-HR-MRU-2	7302	0	0.83	high	100	0.864	0.732
HRO-0313-NEK	253	0.003	0.803	high	67	0.766	0.841
HRO-0313-KASP	44	0	0.595	moderate	55	0.559	0.632
HRO-0313-KZ	34	0	0.639	good	100	0.639	
HRO-0313-MMZ	55	0.001	0.805	high	60	0.84	0.769
HRO-0413-PZK	196	0.002	0.733	good	97	0.797	0.669
HRO-0413-STLP	1	0	0.644	good	100	0.644	

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
HRO-0423-BSK	613	0.006	0.788	good	76	0.766	0.809
HRO-0423-KOR	1564	0.016	0.791	good	85	0.889	0.694
HRO-0423-MOP	2480	0.025	0.883	high	100	0.883	
IT-CAS-C	2092	0	0.845	high	100	0.845	
IT-Ab-1	282	0.005	0.886	high	100	0.886	
IT-Ma-1	319	0.006	0.836	high	100	0.836	
IT-Mo-1	229	0.004	0.808	high	61	0.808	
CAS offshore	**54303**	**0**	**0.71**	**good**	**80**	**0.854**	**0.32**
MAD-HR-MRU-4	18963	0.178	0.897	high	100	0.897	
IT-CAS-O	22393	0.21	0.551	moderate	69	0.783	0.32
Southern Adriatic Sea	**44231**	**0**	**0.858**	**high**	**100**	**0.866**	**0.748**
SAS coastal	**7276**	**0**	**0.769**	**good**	**99**	**0.787**	**0.748**
MAD-HR-MRU-2	4252	0	0.73	good	100	0.805	0.655
HRO-0313-ZUC	13	0	0.792	good	68	0.878	0.705
HRO-0423-MOP	1756	0.031	0.73	good	100	0.805	0.655
IT-SAS-C (Ap-1)	1810	0.013	0.931	high	100	0.897	0.965
MNE-SAS-C	483	0	0.618	good	99	0.517	0.754
MNE-1-N	86	0.001	0.7	good	81	0.7	
MNE-1-C	246	0.002	0.494	moderate	92	0.375	0.613
MNE-1-S	151	0.001	0.812	high	94	0.643	0.981

SAU	**Area (km^2)**	**Total SAU weight factor**	**NEAT value**	**Status Class**	**% Confidence**	**sediments**	**mussels**
MNE-Kotor	85	0.001	0.546	moderate	99	0.333	0.759
AL-SAS-C	646	0.005	0.686	good	95	0.686	
SAS offshore	**36955**	**0**	**0.875**	**high**	**100**	**0.875**	
IT-SAS-O	22715	0.216	0.876	high	100	0.876	
MNE-SAS-O	2076	0	0.882	high	100	0.882	
MNE-12-N	513	0.005	0.869	high	100	0.869	
MNE-12-C	713	0.007	0.891	high	100	0.891	
MNE-12-S	849	0.008	0.883	high	100	0.883	
AL-SAS-O	716	0.007	0.78	good	61	0.78	
MAD-EL-MS-AD	2253	0.021	0.886	high	100	0.886	

4.3.3. The IMAP assessment of the Central Mediterranean (CEN) Sub-region

386. Due to insufficient data, the two sub-divisions of the CEN, the Ionian Sea (IONS) and Central Mediterranean Sea (CENS) were assessed together, by applying the CHASE+ (Chemical Status Assessment Tool) methodology, and stressing possible similarities/differences between them, if available. The assessment findings included in the IMAP Pollution 2023 MED QSR Chapter are based on the thematic assessment (UNEP/MAP - MED POL, 2023). .

<u>Available data</u>

387. Data for the CEN sub-region were very limited. Table 4.3.3.1. summarizes data availability. Trace metals (TM – Cd, Hg and Pb) in sediments were available for 22 stations in Malta, 12 for 2017 and 10 for 2018, belonging to the CENS sub-division, and data for Cd and Pb were available for 4 stations in Greece for 2020, 2 belonging to the IONS sub-division and 2 to the CENS. Concentrations of Σ_{16} PAHs in sediments were available for 21 stations in Greece (20 in the IONS, 1 in CENS), 18 from 2019 and 3 from 2018; and for 5 stations in Tunisia (CENS) for 2019 (Jebara et al. 2021). For Malta (CENS), data for Σ_5 PAHs[40] in sediments were available for 15 stations sampled in 2017 and 10 stations sampled in 2018. Concentrations of total PCBs. i.e. Σ_7 PCBs[41] and individual concentrations for each PCB congener, were reported in sediments for the same 5 stations in Tunisia as for Σ_{16} PAHs (Jebara et al. 2021). Malta reported concentrations of hexachlorobenzene in sediments for 21 stations. Data for trace metals in the fish *M. barbatus* were available for 3 samples from 2017 and 2 samples from 2019 in Malta (CENS). In addition, data for TM in the mussel *M. galloprovincialis* from 2016 and 2017 were retrieved from data reported by Italy to EMODNet: 4 samples with Cd and Pb concentrations and 8 with Hg concentrations.

Table 4.3.3.1. Data available for the environmental assessment of the Central Mediterranean (CEN) Sub-region.

Source	IMAP-File	Country	Sub-division	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs
Sediment										
IMAP-IS	652	Greece	IONS	2018				2	2	
IMAP-IS	652	Greece	CENS	2018				1	1	
IMAP-IS	652	Greece	IONS	2019				18	18	
IMAP-IS	652	Greece	IONS	2020	2	0	2			
IMAP-IS	652	Greece	CENS	2020	2	0	2			
IMAP-IS	489	Malta	CENS	2017	12	12	12		15	
IMAP-IS	489	Malta	CENS	2018	10	10	10		10	
Lit[1]		Tunisia	CENS	2019				5		5
M. galloprovincialis										
EMODNet		Italy	CENS	2016		2				
EMODNet		Italy	CENS	2017	4	6	4			
M. barbatus										

[40] Σ_5 PAHs is the sum of the concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene and Benzo(ghi)perylene. Σ_5 PAHs is a non-mandatory parameters for CI 17, whereby Σ_{16} PAHs, is a mandatory parameter.
[41] PCBs congeners 28,52,101,118,132,153,180

Source	IMAP-File	Country	Sub-division	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs
IMAP_IS	489	Malta	CENS	2017	3	3	3			
IMAP_IS	489	Malta	CENS	2019	2	2	2			

[1]Jebara et al., 2021

388. The data were compiled from the IMAP-IS, as of 31st October 2022. Additional data from the scientific literature (Jebara et al, 2021) and from EMODNet were also used.

389. Based on the available data, the assessment was performed for TM and Σ_{16} PAHs in sediment. In addition, the CEN was assessed based on Σ_5 PAHs in sediments as well. This is not a mandatory parameter, but was included here given significant more data available for Σ_5 PAHs compared to Σ_{16} PAHs (48 vs 28 data points, respectively) encompassing a larger area of the CEN. Therefore, an exception was made to possibly increase confidence of the assessment. A very limited assessment was provided also for the additional parameters: Σ_7 PCBs in sediments, TM in *M. barbatus* and in *M. galloprovincialis* due to the small amount of data available. The 2023 MED QSR needs to be based on data reported as of 2018 onward. However, given limited data availability, an exception was made and data available for 2016 and 2017 were also used in order to increase reliability of the assessment.

Setting the GES/non GES boundary value/threshold for the CHASE+ application in the CEN

390. The thresholds used for the CHASE+ assessment methodology were the updated Mediterranean regional BACs. Table 4.3.3.2 summarizes the thresholds values. For most parameters, the sub-regional BACs were not available (UNEP/MAP – MED POL, 2022). Namely, for sediments, only one CEN_BAC is available for TM (Pb), and for Σ_{16} PAHs. Regarding biota matrix, sub-regional CEN_BACs are not available for TM in *M. barbatus*, while for *M. galloprovincialis*, the CEN_BACs are available for Cd and Hg. By having only 4 CEN BACs, it was impossible to ensure homogenous assessment by combing sub-regional and regional BACs, in particular because the sub-regional BACs were calculated with a few data points as discussed and approved by the Meeting of CorMon Pollution (27 and 30 May 2022)[42]. For this reason, an exception was made for the CEN assessment and it was decided to use only the Mediterranean regional MED_BACs as thresholds in the assessment. It should also be noted that the four sub-regional CEN_BACs are about one order of magnitude lower than the MED_BACs.

391. The boundaries between the 5 environmental classifications (high, good, moderate, poor and bad) are given in Table 2.5.2.a., Section 2.

[42] The CEN sub-region, BACs are multiplications of the BCs (UNEP/MAP – MED POL 2022):

- It was possible to calculate BC for Pb (in sediments) at the CEN sub-region in 2022, however with only 29 data points. The BC value for Pb in CEN was about one order of magnitude lower than the BCs calculated for the other sub-regions and should be re-examined when additional data will be available (Paragraph 38).
- Σ_{16} PAHs in sediments. The lowest values were calculated for the CEN, however the number of data points was low and not representative (Paragraph 39).
- TM in *M. galloprovincialis* .A few data points (4 for Cd and 8 for Hg with 4 Pb, all BDL) were available for the CEN. The calculated BCs were lower than in the other sub-regions, however, the few data is not representative of the CEN (Paragraph 40).
- TM in *M. barbatus*. There were 5 data points available for the CEN, however Cd and Pb were all BDL while the median Hg concentration was 152 µg/kg wet wt, much higher than in the other sub-regions. Given the lack of data for the CEN, it was not possible to propose values for BC in this sub-region, therefore it is suggested to use the regional MED BC values for GES assessment (Paragraph 40).

Table 4.3.3.2. Summary of the threshold values (MED_BACs) used in application for GES assessment of the Central Mediterranean Sea sub-division. Available CEN_BAC and MedEAC values are given for comparison.

	CEN_BAC	MED_BAC	MedEAC
Sediments, µg/kg dry wt			
Cd	#	161	1200
Hg	#	75	150
Pb	2708	22500	46700
Σ_{16} PAHs	9.5	41	4022*
Σ_5 PAHs^	#	31.8	
Σ_7 PCBs	#	0.40	68+
***M. barbatus*, µg/kg wet wt**			
Cd	#	7.8	50
Hg	#	81.2	1000
Pb	#	36.6	300
***M. galloprovincialis*, µg/kg dry wt**			
Cd	117&	1065	5000
Hg	18.5&	117	2500
Pb	#	1650	7500

BACs not available for CEN (UNEP/MED WG.533/3). & Based on 4-8 data points, * ERL value derived for the sum of 16 PAHs by Long et al., 1995, do not appear in the Decisions of COP. + Sum of the individual MedEACs values of the 7 PCB compounds as they appear in Decision IG.23/6.^Values do not appear in Decisions of COP. Calculated as a sum from the individual BAC values for each or the 5 PAHs compounds.

Integration of the areas of assessment for the CEN

392. The locations of the sampling stations/ areas are presented in Figures CEN 5.2.1.C. – CEN 5.2.3.C., Section 5.

393. The locations of the sampling stations were sorted by group of contaminants and matrix. As explained above, data were available mainly for the sediment matrix, with a few data points for TM in the fish *M. barbatus* and the mussel *M. galloprovincialis*.

394. Further to IMAP implementation, the monitoring stations were considered for grouping in the two main assessment zones i.e., the coastal (within 1 nm from the shore) and offshore zones. All the sediment stations reported by Malta were classified as coastal while the stations where M. barbatus specimens were collected were classified as offshore. The 5 sediment stations from Tunisia were classified as coastal (Jebara et al., 2021). For Greece, 11 sediment stations were classified as coastal and 11 as offshore stations. Six of the offshore stations were located in semi-enclosed areas. *M. galloprovincialis* in Italy (data from EMODNet) were collected from one coastal location and three offshore locations.

395. Due to the limited number of data points, more so if dividing into coastal and offshore stations, the spatial nesting of stations in spatial assessment units (SAUs) to the level considered meaningful for IMAP CI 17 was not possible in the CEN. Spatial nesting would decrease the reliability and the representativeness of each station for the assessment. Therefore, at this stage, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.

Results of the CHASE+ Assessment of CI 17 in the the Central Mediterranean Sub-division.

396. For each measured parameter at each station a contamination ratio (CR) was calculated. Thresholds were the MED_BACs as explained above. CHASE+ assessment methodology in the CEN was provided without spatial integration and aggregation of the areas of assessment and assessment results.

Instead, aggregation was possible only for TM in sediments, and only partially. A contamination score (CS) aggregating 2-3 metals was further calculated. Table 4.3.3.3 summarizes the results of the CHASE+ application, while detailed calculation of the assessment results is presented in Figures CEN1-CEN3, Section 5 (UNEP/MAP – MED POL, 2023)

Table 4.3.3.3. Number of data points and their percentage from the total number of data points in each category based on the CHASE+ tool, calculated using the proposed new MED_BACs (UNEP/MAP - MED POL 2023).

CHASE+		**Blue** **High**	**Green** **Good**	**Yellow** **Moderate**	**Brown** **Poor**	**Red** **Bad**
		NPA or GES		**PA or non-GES**		
Sediment	Total number of data points					
		CS=0.0-0.5	**CS =0.5-1.0**	**CS =1.0-2**	**CS =2-5**	**CS >5**
Cd, Hg, Pb	26*	23	0	1	0	2
% from total number of data points		*88*	*0*	*4*	*0*	*8*
		CR=0.0-0.5	**CR=0.5-1.0**	**CR =1.0-2**	**CR =2-5**	**CR>5**
Σ_{16} PAHs	26	12	4	4	5	1
% from total number of data points		*46*	*15*	*15*	*19*	*4*
Σ_5 PAHs	46	25	6	5	6	4
% from total number of data points		*55*	*13*	*11*	*13*	*9*

* 4 stations with Cd and Pb only.

Assessment of Trace metals in sediments of the CEN

397. Data for TM were available for 26 stations: 22 from Malta with all three TM (Cd, Hg and Pb) and 4 from Greece with Cd and Pb only. Most stations (23) were classified in high status (Figure CEN 5.2.1.C, Section 5 (UNEP/MAP - MED POL, 2023). One station, in the IONS offshore, was classified in moderate status due to the concentration of Cd. Two stations were classified in poor status due to the high concentrations of Hg and Pb. These two stations were located at the Port il- Kbir off Valetta, an area affected by industrial plants and marine traffic.

398. Although most of the stations (88%) were in-GES, it is not possible to classify the Sub-region nor the sub-division as a whole. Twenty-two sampling stations were located along the coast of Malta (CENS), 2 on the offshore area of the IONS and 2 on the offshore of the CENS. Due to the uneven distribution of the stations, it is not possible to assess an environmental status to the whole sub-region regarding TM in sediments.

Assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments of the CEN

399. Σ_{16} PAHs in sediments were available only for 21 stations in Greece (20 in the IONS, 1 in CENS) and 5 stations in Tunisia (CENS)[43]. All the stations in Tunisia were classified in-GES and assigned a high environmental status. Out of the 21 stations reported by Greece, 12 stations (52%) of the stations were in-GES and 10 were non-GES (48%), with 4 stations in moderate status, 5 stations in poor status and 1 station in bad status (Figure CEN 5.2.2.C, Section 5; UNEP/MAP -MED POL, 2023). The non-GES stations were located along the eastern Ionian coast, in the Gulf of Patras and the Gulf or Corinth, with 4 stations in poor status and one station in bad status in Kerkyraiki. Due to the lack of data it was not possible to classify the environmental status to the whole sub-division nor the sub-region with respect to Σ_{16} PAHs in sediments.

400. Σ_5 PAHs in sediments were available only for 21 stations in Greece (20 in the IONS, 1 in CENS) and 25 stations in Malta (CENS). The classification of the stations reported by Greece were better using Σ_5 PAHs compared to Σ_{16} PAHs: 16 stations (76%) of the stations were in-GES and 5 were non-GES (24%), with 3 stations in moderate status, 2 stations in poor status and no station in bad status. Non-GES stations were located in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki. Out of the 25 stations reported by Malta, 15 stations (60%) of the stations were in-GES and 10 were non-GES (24%), with 2 stations in moderate status, 4 stations in poor status and 4 stations in bad status (Figure CEN 5.2.3.C, Section 5;UNEP/MAP - MED POL, 2023). The non-GES stations were located at the north-eastern and south-eastern part of Malta, in particular two stations were located at the Port il- Kbir off Valetta, an area affected by industrial plants and marine traffic, and impacted by TM in sediments as well, as explained for Trace metals. Two additional stations in bad status were located at the Operational Wied Ghammieq, affected by industrial plants. However, due to the lack of data and uneven distribution of the stations it was not possible to classify the environmental status to the whole sub-division nor the sub-region with respect to Σ_5 PAHs in sediments. It must also be noted that in the absence of data reported for Σ_{16} PAHs, as mandatory parameter, these initial findings were provided as indicative for Σ_5 PAHs, as non-mandatory parameter reported by the two CPs.

Assessment of Σ_7 PCBs in sediments of the CEN

401. Σ_7 PCBs in sediments were available only for 5 stations in Tunisia (CENS)[44]. Four of the stations were classified in-GES, in good status while only one, Chebba, was classified as non-GES, in moderate status (UNEP/MAP – MED POL, 2023). Concentrations of all individual PCBs were higher at the location of Chebba than those from other locations, which could be linked to the discharge of wastewater from the neighboring fishing port in this area (Jebara et al., 2021).

Assessment of Organochlorinated contaminants other than Σ_7 PCBs in sediments of the CEN

402. Malta reported the concentration of hexachlorobenzene in sediments, one of the mandatory organochlorine contaminants, for 22 stations. All the concentrations were below the detection limit of 0.05 μg/kg dry wt. Therefore, this compound could not be used for GES assessment.

Assessment of Trace metals in biota of the CEN

403. *M. barbatus*: Cd and Pb in all the 5 samples for which Malta reported data were below the detection limit (100 and 250 for Cd and Pb, respectively). The detection limits were much higher than the MED_BACs for these metals in *M. barbatus* (Table 4.3.3.2). Hg in all the 5 samples were non-GES, with 3 samples classified in moderate status, one in poor status and one in bad status (UNEP/MAP - MED POL, 2023).

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[43] Jebara et al., 2021
[44] Jebara et al., 2021

404. *M. galloprovincialis*. Data were available only for Italy (EMODNet). All the 8 samples were in-GES, 7 classified in high status and one in good status (UNEP/MAP – MED POL, 2023).

4.3.4. The IMAP GES assessment of the Western Mediterranean Sea (WMS) Sub-region

405. The GES for IMAP CI 17 was assessed by applying the NEAT tool on the Western Mediterranean nested scheme in line with the elaboration of the integration and aggregation rules provided for the NEAT tool application in the Adriatic Sea Sub-region, including optimal temporal and spatial integration and aggregation of the assessment findings within nested approach agreed for IMAP implementation. For the purposes of the present work data on contaminants produced within implementation of the national monitoring programmes of the CPs and reported to the IMAP IS or submitted to UNEP/MAP have been gathered. As explained in Section 2, IMAP SAUs have been defined for the whole WMS, however, based on findings regarding data availability it was possible to obtain reliable assessment results by using the NEAT tool only for the coastal assessment zones of the Alboran and the Tyrrhenian sub-divisions (ALBS, TYRS), whereby a simplified application of the NEAT tool was chosen only for the IMAP SAUs for which data exist without any spatial integration on the CWMS level.

<u>Available data</u>

406. Data on contaminants (Cd, Hg, Pb, PAHs and PCBs) have been collected from the following Contracting Parties bordering the Western Mediterranean Sea for the years 2017 to 2022: France, Italy, Morocco, Spain. In addition, some data for sediments acquired in 2016 and not used in previous assessment have been included in the present work, in order to increase the amount of data, i.e. reliability of the assessment findings. Details on the temporal and spatial availability of data per IMAP SAUs, per environmental matrix (sediments, biota) and per contaminants group (trace metals (TM), PAHs, PCBs) are provided here-below in Table 4.3.4.1 and elaborated in Table II in Annex IX (CH 4.3.4). The biota matrix is monitored for mussels *Mytilus galloprovincialis* in all cases. The spatiotemporal coverage varies largely among the various IMAP SAUs. Data for the Alboran Sea were reported for 5 out of 8 coastal SAUs, and no data were reported for any offshore SAUs. Data reported by Morocco refer to Cd, Hg, Pb in sediments and biota, while data reported by Spain refer to Cd, Hg, Pb and PCB on biota only. Algeria has not reported any data for the period 2017-2022. Data for the Central part of the Western Mediterranean Sea (CWMS) have been reported only by France, Spain and Italy. France and Spain reported data mostly for biota and only for stations situated in the coastal zone, i.e. France on Cd, Hg, Pb, PAHs and PCBs, and Spain on Cd, Hg, Pb and PCBs. Data for sediments were reported by France (Cd, Hg, Pb) and Spain (PAHs, PCBs, Cd, Hg, Pb) for 2016 only, mostly in coastal waters. Italy in CWMS reports data for sediments only (Cd, Hg, Pb, PAHs, PCBs). In the Tyrrhenian Sea (TYRS) for 6 out 7 coastal SAUs data were reported on contaminants. These are data reported by Italy for sediments on Cd, Hg, Pb, PAHs and PCBs, and data reported by France for biota on Cd, Hg, Pb, PAHs and PCBs and for sediments on Cd, Hg, Pb. Data for biota reported by Italy are very limited, confined to only 2 coastal SAUs and only for Hg, hexachlorobenzene and fluoranthene, hence they were not included in the assessment. Overall, for all sub-divisions of the WMS no data were reported for offshore IMAP SAUs, with the exception of one station sampled once for metals in biota in ES-CWM-LEV1-O SAU and 9 stations sampled for PAHs, PCBs, Cd, Hg, Pb in ES-CWM-LEV1-O SAU and one station in ES-CWM-LEVOS-O SAU, all during 2016.

407. As explained above in Section 2, a set of criteria (e.g. representativeness/importance of the areas of monitoring for establishing 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) was applied to propose the scope of the areas of monitoring. Namely, the first element that was considered for the implementation of the nested approach is the definition of the areas of assessment within the Western Mediterranean Sea based

on the areas of monitoring. The existing monitoring and assessment areas defined by the concerned CPs were used, in case they were compatible with IMAP requirements; in case of the Contracting Parties that are EU MS, if inconsistency appeared between IMAP requirements and MSFD MRUs, the necessary adjustments were undertaken.

408. To better understand differences in the spatial coverage of the SAUs the percentage (%) of surface area of the IMAP SAUs with monitoring data reported to the total area of the coastal assessment zone is calculated and shown in Table I in Annex IX (CH 4.3.4). Further to this criterion, the spatial distribution of monitoring stations and its comparison with the sufficiency of quality-assured data as collated for NEAT application were analyzed as provided here-below in Table 4.3.4.1 and elaborated in Table I in Annex IX (CH 4.3.4). Table II in Annex IXI (CH 4.3.4) provides the spatial coverage of monitoring data collected per each SAU in the Western Mediterranean Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately. Table 4.3.4.1. and Table III in Annex IX (CH 4.3.4)) provides the temporal coverage of monitoring data used again per each SAU in the Western Mediterranean Sea and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately.

409. For the scope of CI17 monitoring in the Western Mediterranean Sea, the CPs have set 91.5% of the monitoring stations in the coastal zone and no data on contaminants were reported for the period 2017-2022 for any of the offshore stations. Only some data on sediments in Spanish offshore waters were reported for 2016 corresponding to 4% of total number of records. Despite that data were reported for 67% of the coastal IMAP SAUs in the CWMS by France, Spain and Italy, whereby there is a lack of data for whole southern coasts of Algeria and Tunisia. Hence the integrated assessment using the NEAT tool for this subdivision would be unreliable (Table I Annex IX (CH 4.3.4)). In addition, based on the highest spatiotemporal coverage of data per matrix and per contaminant, reliable assessments using the NEAT tool can be made for the coastal zone of ALBS subdivision for metals in sediments and biota and for the coastal zone of TYRS subdivision for metals, PAHs and PCBs in sediments. The coastal part of the subdivision CWMS corresponding to French, Spanish and Italian monitoring areas was assessed just for the 1st level using the NEAT tool without any further spatial integration.

Table 4.3.4.1. Data available for the environmental assessment of the Western Mediterranean Sea (WMS) Sub-region.

Source	**IMAP-File**	**Country**	**Year**	**Cd**	**Hg**	**Pb**	**Σ_{16} PAHs**	**Σ_5 PAHs**	**Σ_7 PCBs**	**Lindane**	**Dieldrin**	**Hexachlorobenzene**	**p,p' DDE**
Sediment													
IMAP_IS	224	France	2016	23	23	23							
EMODNet		France	2016	27	27	27	29	29					
IMAP_IS	469	Italy	2016	98	56	98		49	7	77		77	
IMAP_IS	469	Italy	2017	55	50	42		14		31		31	
IMAP_IS	469	Italy	2018	98	94	88		56	25	68		68	
IMAP_IS	469	Italy	2019	55	42	53		24		39		0	
IMAP_IS	243	Morroco	2016	11		11							
IMAP_IS	243	Morroco	2017	11	11	11							
IMAP_IS	243	Morroco	2018	11	11	11							
IMAP_IS	593	Spain	2016	54	54	54			54	54	54	54	54
IMAP_IS	623	Spain	2016					54					

Source	IMAP-File	Country	Year	Cd	Hg	Pb	Σ_{16} PAHs	Σ_5 PAHs	Σ_7 PCBs	Lindane	Dieldrin	Hexachlorobenzene	p,p' DDE
M. galloprovincialis													
IMAP-IS	495	France	2018	23	23	23	23	23		23	23	23	
EMODNet		France	2017	3	3	3		2					
IMAP-IS	494	Italy	2016		12							12	
IMAP-IS	494	Italy	2017		23							23	
IMAP-IS	494	Italy	2018		15							13	
IMAP_IS	494	Italy	2019									2	
IMAP_IS	650	Morocco	2019	4	4	4							
IMAP_IS	650	Morocco	2020	4	4	1							
IMAP_IS	650	Morocco	2021	4	4	4							
IMAP_IS	517	Spain	2017						25	25	25	25	25
IMAP_IS	619	Spain	2017	25	25	25							
IMAP_IS	620	Spain	2019	45	45	45							

410. For the application of the NEAT software, data on contaminants were grouped per parameters, ecosystem components (i.e. for the purpose of present NEAT application these are considered biota and sediment matrixes) and SAUs in the Western Mediterranean sub-divisions. Average concentrations (arithmetic means) and their respective standard errors were then calculated in the respective groups as explained above for the Adriatic Sea Sub-region (see paragraph 286, Section 4.3.2).

411. Several records on PAHs and PCBs individual compounds were reported as below detection limit values (DL) or were left blank. In a separate technical paper, prepared by MED POL in consultations with OWG EO9, it was recommended to incorporate into the BC and BAC calculations of the BDL values and not to exclude them[45.] For the present application of NEAT these cases were substituted by the BDL/2 value, given a rather small quantum of data available, this does not influence the calculation of the assessment findings. In the Slovenian data, the BDL values were left blank so these were substituted by a value equal to 1µg/kg which corresponds to the average BDL/2 value from the whole data set. Furthermore, due to this fact, but also considering the list of substances the monitoring of which is mandatory according to IMAP[46], the sum of the 16 EPA compounds (Σ_{16}PAHs) and sum of the 7 PCBs compounds (Σ_7PCBs) was taken into account for the present assessment. In this way the assessment results show the cumulative impact by each of these two groups of contaminants.

412. Several records on PAHs and PCBs individual compounds were reported as below detection limit values (DL) or equal to the limit of quantification (LOQ). In a separate technical paper, prepared by MED POL in consultations with OWG EO9, it was recommended to incorporate the calculations of the BDL

[45] In a separate technical paper, prepared by MEDPOL in consultations with OWG on Contaminants, it was suggested to 'replace BDL values with a fraction of the reported value. The fraction could be 1 (BDL value), 0.5 (BDL/2), 0.7 (BDL/SQRT(2)), other' and not exclude BDL values from BC calculation. The decision to replace BDL with the reported value or a fraction of it should be based on the available data and expert evaluation. Italy, Spain and France supported the use of LOD/2 or LOQ/2 in the BCs calculation. Israel pointed out that the US- EPA suggests this only when less than 15% of the data is BDLs. Therefore, the calculation for the assessment criteria was performed with the reported value and not half of it (UNEP/MAP – MED POL 2022). This is because the wide range of BDL values for a specific contaminant in a specific matrix, depending on the country and it varies even within the country.

[46] According to IMAP i.e. IMAP Guidance Fact Sheet and Data Dictionaries for IMAP CI 17, monitoring of the sum of 7 PCB congeners: 28, 52,101,118,138,153 and 180 and sum of 16 US EPA PAHs is considered mandatory.

values into the calculation of the BC and BAC and not to exclude them[47]. For the present application of NEAT, BDL were substituted by the BDL/2 value for data reported by Morocco for Hg in sediments. All data reported by Spain are above DL. In the data reported by Italy, LOQ values were reported, and these were not uniform for the whole data set. LOQs for the same chemical parameter varied from 0.1 to 10 μg/kg. To compensate the high variability in the LOQs, the LOQ/2 value was used only for those records with reported LOQs equal to 5 and 10 μg/kg. The LOD, LOQ values were analyzed in detail, as reported by the CPs in the data files (UNEP/MAP – MED POL, 2023). Furthermore, considering the list of substances the monitoring of which is mandatory according to IMAP[48], the sum of the 16 EPA compounds (Σ_{16}PAHs) and sum of the 7 PCBs compounds (Σ_7PCBs) were taken into account for the present assessment. In this way the assessment results show the cumulative impact by each of these two groups of contaminants, similarly to the CI17 assessment made for the Adriatic Sea subregions (UNEP/MAP - MED POL, 2022; 2023).

413. A data compilation per SAU, matrix and contaminant was prepared for all the Western Mediterranean data available and given below in Annex IX of the present document (UNEP/MAP – MED POL 2023).

The integration of the areas of assessment and assessment results by applying the 4 levels nesting approach

414. Following the rules of integration of assessments within the nested approach, for the assessment of EO9 Common Indicators, the coastal and the offshore monitoring zones were set as explained above (paragraphs 289 and 290, section 4.3.2).

415. Detailed explanation on the data sources used and methodology followed for setting of the two zones (coastal and offshore) along with SAUs is provided for the purpose of the present work in the Western Mediterranean, as elaborated in UNEP/MED UNEP/MED WG.556/Inf.15. In summary, GIS layers collected from different sources (International Hydrographic Organization - IHO, European Environment Information and Observation Network - EIONET, VLIZ Maritime Boundaries Geodatabase; EEA Marine Regions portal) were used for the present work for Italy, France, Spain, Morocco, Algeria, Tunisia.

416. For IMAP CI 17, integration of assessments up to the subdivision level is considered meaningful. Therefore, three main subdivisions of the Western Mediterranean Sea, have been considered: The Alboran Sea (ALBS); The Tyrrhenian Sea (TYRS) and the Central part of the Western Mediterranean Sea (CWMS), following the specific geomorphological features based on the IHO data49. The coverage of the 3 sub-divisions is shown in Figure 4.3.4.1.

[47] In a separate technical paper, prepared by MEDPOL in consultations with OWG on Contaminants, it was suggested to 'replace BDL values with a fraction of the reported value. The fraction could be 1 (BDL value), 0.5 (BDL/2), 0.7 (BDL/SQRT(2)), other' and not exclude BDL values from BC calculation. The decision to replace BDL with the reported value or a fraction of it should be based on the available data and expert evaluation. Italy, Spain and France supported the use of LOD/2 or LOQ/2 in the BCs calculation. Israel pointed out that the US- EPA suggests this only when less than 15% of the data is BDLs. Therefore, the calculation for the assessment criteria was performed with the reported value and not half of it (UNEP/MAP MED POL 2022). This is because the wide range of BDL values for a specific contaminant in a specific matrix, depending on the country and it varies even within the country.

[48] According to IMAP i.e. IMAP Guidance Fact Sheet and Data Dictionaries for IMAP CI 17, monitoring of the sum of 7 PCB congeners: 28, 52,101,118,138,153 and 180 and sum of 16 US EPA PAHs is considered mandatory.

[49] Limits of oceans and seas (1953). 3rd edition. IHO Special Publication, 23. International Hydrographic Organization (IHO): Monaco. 38 pp.

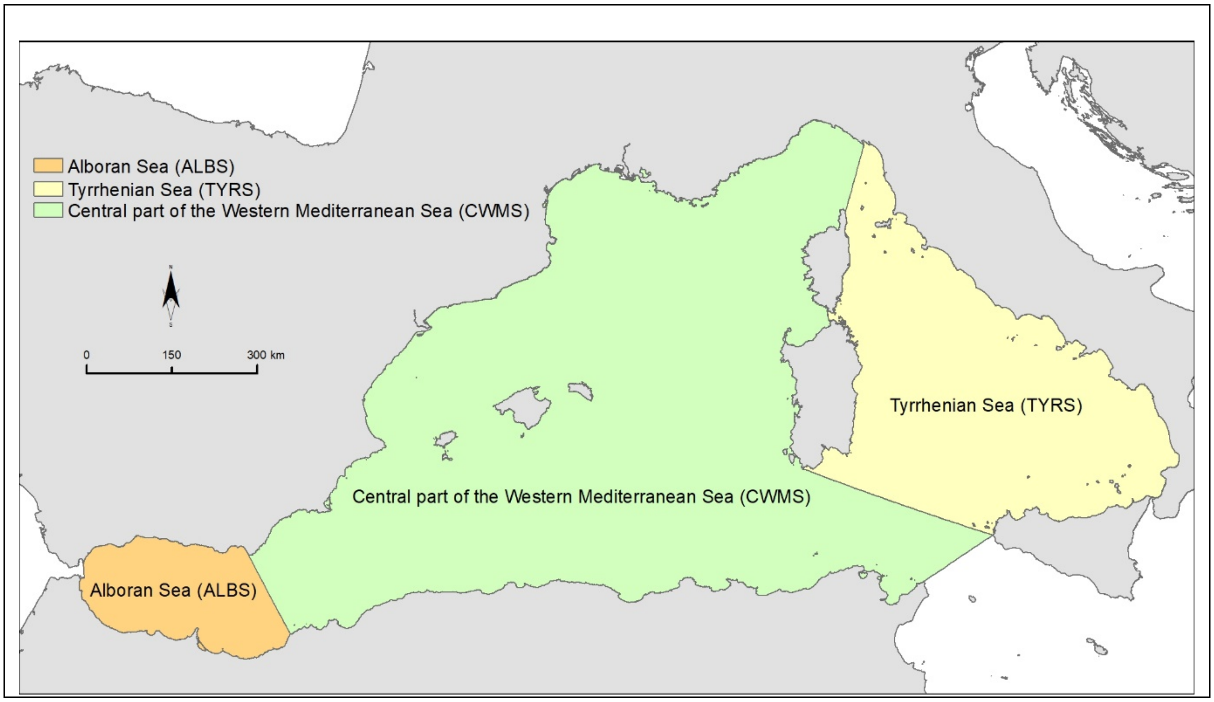

Figure 4.3.4.1. The 3 subdivisions of the Western Mediterranean Sub-Region defined, based on IHO data.

417. The four following steps for integration of the areas of assessment was followed to accomplish the objectives of the NEAT IMAP GES Assessment (UNEP/MAP - MED POL, 2023):

- Step 1 "Defining coastal and offshore waters";
- Step 2 "Recognizing scope of IMAP areas of monitoring";
- Step 3 "Setting IMAP area of assessment":
- Step 4 **"**Nesting of the areas of assessment within the application of NEAT tool": For this step of nesting, the areas of assessment were first classified under the 3 subdivisions of the Western Mediterranean Sea (i.e. ALBS, CWMS, TYRS). A 4 levels nesting approach, as applied in the Adriatic Sea Sub-region was also set for the Western Mediterranean Sub-region (Figure 4.3.4.2a), where the 1st level is the finest, providing nesting of all the finest areas of assessment i.e. the national IMAP SAUs & subSAUs within the two key IMAP assessment zones per country i.e. coastal and offshore zones and the 4th level is the highest.

418. However, for the scope of CI17 monitoring in the Western Mediterranean Sea, the CPs have set 91,5% of the monitoring stations in the coastal zone and no data on contaminants were reported for the period 2017-2022 for any of the offshore stations. In addition, only 53% of the coastal IMAP SAUs & sub SAUs for the CWMS reported data (by France and Spain) which makes any spatial integrated assessment using the NEAT tool unreliable for this subdivision. For these reasons, it was not considered meaningful to proceed with a 4 levels' nesting scheme in all 3 sub-divisions as shown in Figure 4.3.4.2a.

419. Therefore, only the coastal SAUs were considered and nested under a 2 levels` hierarchical scheme and the integration of the assessment results was conducted for the coastal zone of the Alboran (ALBS) and Tyrrhenian Seas (TYRS) sub-divisions as follows:

- 1st level provided nesting of all national IMAP subSAUs within the coastal IMAP assessment zone per country;

- 2nd level provided nesting of the national coastal IMAP assessment zones on the subdivision level i.e., i) ALBS coastal; ii) TYRS coastal.

420. Similarly, the integration of the assessment was conducted in 2 levels as follows:

- 1st level: Detailed assessment results provided for all national coastal subSAUs and SAUs (ALBS, TYRS, some IMAP subSAUs of CWMS)
- 2nd level: Integrated assessment results provided for the coastal zone: i) ALBS coastal; ii) TYRS coastal.

421. The graphical depiction of this nesting scheme for the ALBs and TYRS is shown in Figure 4.3.4.2.b. The description of the IMAP SAUs and details on specificities for each country are also provided (UNEP/MAP - MED POL, 2023).

422. Given the integrated assessment up to the 2nd level using the NEAT tool was unreliable for CWMS, the assessment of this subdivision was undertaken just for the 1st level and only for those IMAP subSAUs for which data exist.

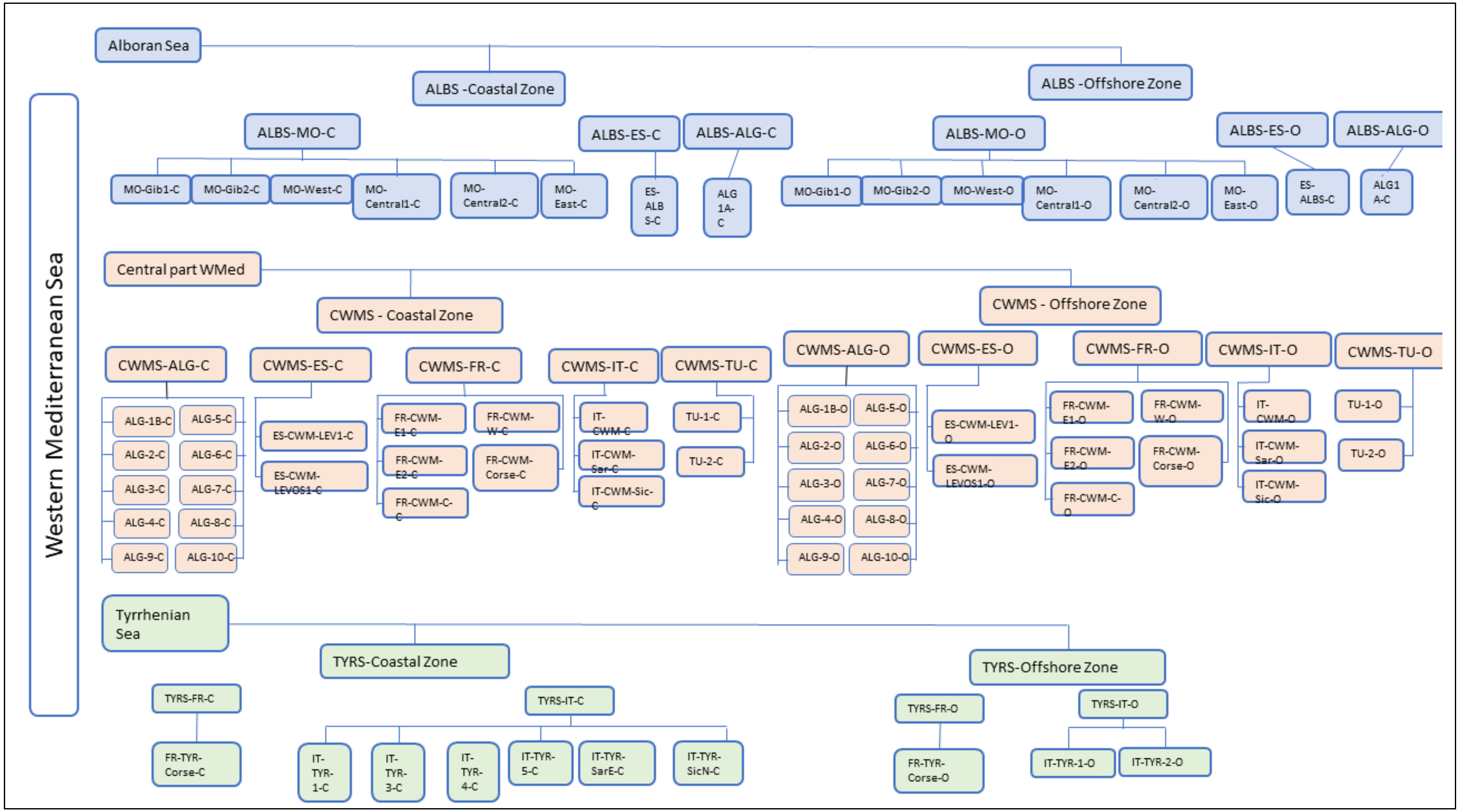

Figure 4.3.4.2 (a): The nesting scheme of the SAUs defined for the Western Mediterranean Sea Sub-region based on the available information.

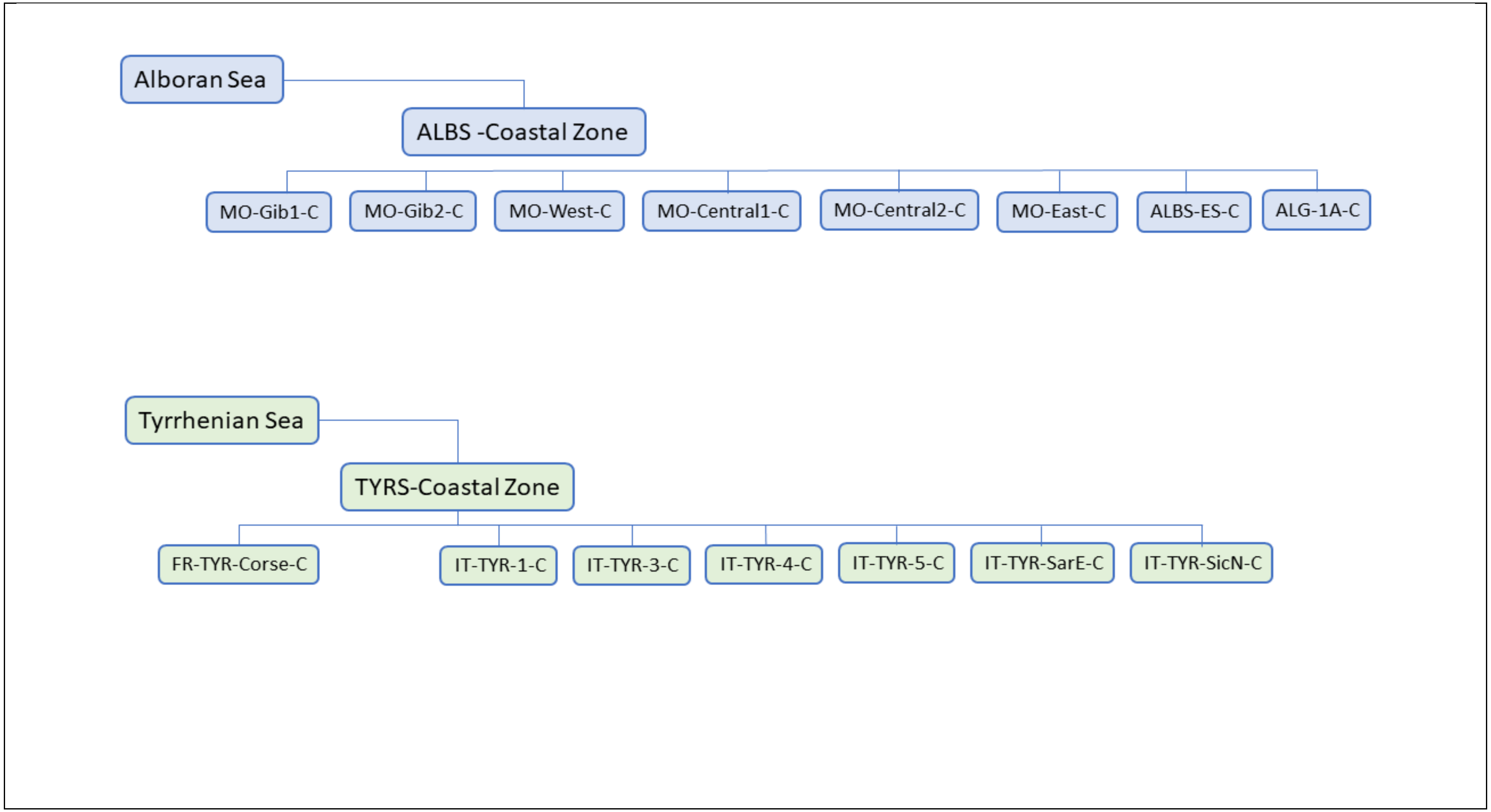

Figure 4.3.4.2 (b): The 2 level nesting scheme for the Alboran and Tyrrhenian Seas Sub-divisions used for the present assessment of CI17 by applying the NEAT tool.

423. Further to spatial analysis of the monitoring stations distribution, along with recognition of corresponding monitoring and assessment areas, as well as optimal nesting of the finest areas of assessment, as described in Section 2 (UNEP/MAP - MED POL, 2023), the scope of all WMSSAUs and subSAUS were defined. All of them were introduced in the NEAT tool along with their respective codes and surface area (km^2).

424. The procedure for use by the NEAT tool of data related to SAUs surface, boundary limits, the class threshold values, the concentrations of the group of contaminants assessed, along with normalization of the values, is explained above in section 4.3.2 (UNEP/MAP - MED POL, 2023).

Setting the GES/non GES boundary value/threshold

425. As explained (section 4.3.2), the present assessment analysis applying the NEAT tool was conducted for each subdivision using the assessment criteria for the GES-nonGES threshold, based on BAC values are shown in Table 4.3.4.2, as approved by the Meeting of CorMon Pollution Monitoring (UNEP/MAP - MED POL, 2022) and following the recommendations related to the Tyrrhenian Sea as discussed during the Meeting of the SIDA funded Project "Toward integration ecosystem assessment and ecosystems management approach in the Adriatic Sea Sub-region" (10 November 2022, Tunisia).

Table 4.3.4.2: The BAC values calculated for the Western Mediterranean Sea and used for the present assessment

	WMED BAC (µg/kg dry wt)	
	Sediments	**Biota (MG)**
Cd	210	1545
Hg	135	120
Pb	24000	1890
$^{*}\Sigma_{16}$ PAHs	240	8.4
$^{+}\Sigma_{7}$ PCBs	1.6	28.6

426. In line with an updated assessment classification for a harmonized application of NEAT and CHASE+ tools in the four Mediterannean Sea sub-regions (UNEP/MAP – MED POL, 2023), the Boundary limits of the 5-class assessment scale and class Threshold values were applied for NEAT GES Assessment of the Western Mediterranean Sea-Sub-region (Table 4.3.4.3).

Table 4.3.4.3: Boundary limits of the assessment scale and class Threshold values used for the application of the NEAT tool for IMAP.

	Low Boundary limit	**Threshold** High/Good	**Threshold** Good/Moderate	**Threshold** Moderate/Poor	**Threshold** Poor/Bad	**Upper Boundary Limit**
Sediments	**(µg/kg)**	**0.5(xBAC) (µg/kg)**	**xBAC (µg/kg)**	**2(xBAC) (µg/kg)**	**5(xBAC) (µg/kg)**	**Max. conc. (µg/kg)**
Cd	0	157	315	630	1575	1600
Hg	0	101	202	404	1013	1950
Pb	0	18000	36000	72000	180000	190000
$^{*}\Sigma_{16}$ PAHs	0	240	480	960	2400	30690
$^{+}\Sigma_{7}$ PCBs	0	1.6	3.2	6.4	16	120

Biota (*M. galloprovincialis*)						
Cd	0	1159	2318	4635	11588	12000
Hg	0	90	180	*360*	900	1214
Pb	0	1417	2835	*5670*	14175	15000
$^{*}\Sigma_{16}$ PAHs	0	8.4	16.8	33.6	84	286
$^{+}\Sigma_{7}$ PCBs	0	28.5	57	114	285	290

*sum of the individual BACs or xBACs values of the 16 PAH compounds
$^{+}$ sum of the individual BACs or xBACs values of the 7 PCB compounds

427. The data (i.e. average values inserted), as well as boundary limits and threshold values are normalized by NEAT in a scale of 0 to 1 to be comparable among parameters and to facilitate aggregation on the CI or EO level, as explained above in section 4.3.2.

Results of the IMAP NEAT GES Assessment of CIs 17 in the Western Mediterranean Sea Sub-region

428. The assessment was conducted in the ALBS for Cd, Hg, Pb in sediments and biota and in the TYRS for Cd, Hg, Pb, Σ_{16}PAHs and Σ_{7}PCBs in sediments. The simplified application of the NEAT tool (1st level nesting) was applied for the IMAP SAUs of the CWMS for which data on contaminants exist (Cd, Hg, Pb, Σ_{16}PAHs and Σ_{7}PCBs in sediments and biota).

429. The results obtained from the NEAT tool using the (xBAC) threshold for the Alboran Sea subdivision (ALBS) are shown below in Table 4.3.4.4.

430. The detailed status assessment results per contaminant show that most SAUs achieve GES conditions (high, good status) indicated by the blue and green cells. Exceptions to this are moderate classifications for SAUs MO-East-C and ALBS-ES-C for Pb in sediments, MO-Gib2-C for Cd in sediments, and SAU ALBS-ES-C for Hg in mussels.

431. The results obtained from the NEAT tool using the (xBAC) thresholds for the Tyrrhenian Sea subdivision (TYRS) are shown below in Table 4.3.4.5.

432. Detailed assessment results for the TYRS subdivision show that SAUs IT-TYR-1-C, IT-TYR-3-C and IT-TYR-4-C fall into moderate status regarding Cd in sediments; regarding Hg in sediments SAUs IT-TYR-1-C and IT-TYR-3-C fall into moderate and poor statuses respectively. Finally, SAU IT-TYR-4-C is classified as moderate regarding Σ_{7}PCBs.

433. The Tabulated NEAT results of Tables 4.3.4.4 and 4.3.4.5 (schematic presentation, UNEP/MAP - MED POL, 2023).

434. The results obtained from the simplified application of NEAT for the coastal sub-SAUs with data in the CWMS are shown below in Table 4.3.4.6, and Figure WMS 5.2.3.C (Section 5). Detailed assessments per contaminant per SAU indicate non-GES status for several cases. Regarding sediments SAU ES-CWM-LEV1-C is classified under moderate status for Pb and SAU FR-CWM_E2-C under poor for Hg. The Italian SAU IT-CWM-C is classified under moderate for Cd and under poor status for Σ_{16}PAHs and Σ_{7}PCBs. Monitoring data for mussels show that SAU FR-CWM-E2-C is classified under moderate status for Hg and Pb and under poor for Σ_{16}PAHs; SAUs FR-CWM-C-C and FR-CWM-W-C are classified under poor and moderate status respectively regarding Σ_{16}PAHs.

Table 4.3.4.4. Status assessment results of the NEAT tool applied on the 2 levels nesting scheme in the Alboran Sea Sub-division, using the xBAC as GES-nGES threshold for the assessment of EO9/CI17. The 2nd level of spatial integration (nesting) on the coastal zone is marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis (UNEP/MAP – MED POL, 2023).

SAU	Area (km^2)	Total SAU weight	NEAT value	Status class	% Confidence	CI17_Cd_seds	CI17_Hg_seds	CI17_Pb_seds	CI17_Cd_mus	CI17_Hg_mus	CI17_Pb_mus
ALBS-coastal	**4900**	**0**	**0.757**	**good**	76.5	**0.621**	**0.971**	**0.754**	**0.909**	**0.592**	**0.749**
MO-East-C	700	0.211	0.846	high	100	0.635	0.98	0.572	0.941	0.977	0.972
MO-Central1-C	805	0									
MO-Central2-C	361	0.109	0.824	high	97.5	0.606	0.98	0.924	0.908	0.733	0.79
MO-West-C	286	0.086	0.824	high	94.2	0.628	0.931	0.968	0.894	0.74	0.783
MO-Gib2-C	67	0.02	0.779	good	67.4	0.573	0.98	0.785			
MO-Gib1-C	71	0									
ALBS-ES-C	1908	0.574	0.701	good	79.9				0.905	0.497	0.702
ALBS-ALG-1A-C	702	0									

Table 4.3.4.5. Status assessment results of the NEAT tool applied on the 2 levels nesting scheme in the Tyrrhenian Sea Sub-division, using the xBAC as GES-nGES threshold for the assessment of EO9/CI17. The 2nd level of spatial integration (nesting) on the coastal zone is marked in bold. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis (UNEP/MAP – MED POL, 2023).

SAU	Area (km^2)	Total SAU weight	NEAT value	Status class	% Confidence	CI17_Cd_seds	CI17_Hg_seds	CI17_Pb_seds	Σ_{16}PAHs_seds	Σ_7PCBs_seds	CI17_Cd_mus	CI17_Hg_mus	CI17_Pb_mus	Σ_{16}PAHs_mus	Σ_7PCBs_mus
TYRS-C	**27511**	**0**	**0.739**	**good**	99.9	**0.66**	**0.674**	**0.786**	**0.873**	**0.72**	**0.711**	**0.68**	**0.813**	**0.619**	**0.99**
FR-TYR-Corse-C	648	0	0.821	high	92.3	0.949	0.913	0.778			0.711	0.68	0.813	0.619	0.99
IT-TYR-1-C	6363	0.263	0.738	good	99.7	0.552	0.582	0.771	0.969	0.816					
IT-TYR-3-C	4122	0.17	0.712	good	100	0.489	0.398	0.806	0.933	0.934					
IT-TYR-4-C	8072	0.334	0.64	good	89.7	0.578	0.75	0.709	0.725	0.44					
IT-TYR-5-C	2685	0													
IT-TYR-SarE-C	2598	0.107	0.832	high	74.7	0.88	0.81	0.806							
IT-TYR-SicN-C	3023	0.125	0.939	high	100	0.971	0.804	0.967	0.983	0.972					

Table 4.3.4.6. Status assessment results of the NEAT tool applied on the 1st level IMAP subSAUs in the Central part of the Western Mediterranean Sea Sub-division, using the xBAC as GES-nGES threshold for the assessment of EO9/CI17. Blank cells denote absence of data. The % confidence is based on the sensitivity analysis (UNEP/MAP – MED POL, 2023).

SAU	**NEAT value**	**Status class**	**% Confidence**	**CI17_Cd_seds**	**CI17_Hg_seds**	**CI17_Pb_seds**	**Σ_{16}PAHs_seds**	**Σ_{7}PCBs_seds**	**CI17_Cd_mus**	**CI17_Hg_mus**	**CI17_Pb_mus**	**Σ_{16}PAHs_mus**	**Σ_{7}PCBs_mus**
ES-CWM-LEV1-C	0.788	Good	80.8	0.823	0.804	0.598	0.935	0.875	0.896	0.749	0.639		0.796
FR-CWM-E1-C	0.858	High	100	0.936	0.969	0.833			0.758	0.658	0.76	0.87	0.972
FR-CWM-E2-C	0.61	Good	74.2	0.896	0.375	0.621			0.838	0.524	0.538	0.228	0.818
FR-CWM-C-C	0.77	Good	98.9	0.869	0.855	0.793			0.881	0.673	0.775	0.315	0.86
FR-CWM-W-C	0.81	High	84.9	0.936	0.961	0.761			0.844	0.74	0.727	0.419	0.937
FR-CWM-Corse-C	0.816	High	82.2	0.924	0.888	0.661			0.729	0.698	0.813	0.81	0.99
IT-CWM-C	0.476	Moderate	99.1	0.484	0.675	0.716	0.2	0.304					

4.4. Assessment of IMAP Common Indicator 18: Level of pollution effects of key contaminants where a cause and effect relationship has been established

Geographical scale of the assessment	The Sub-regions within the Mediterranean region by using scientific literature sources
Contributing countries	Countries in alphabetical order: Algeria, Egypt, Italy, Spain, Tunisia, Türkiye based on scientific literature sources
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI18. Level of pollution effects of key contaminants where a cause and effect relationship has been established
GES Definition (UNEP/MED WG473/7) (2019)	Concentrations of contaminants are not giving rise to acute pollution events
GES Targets (UNEP/MED WG473/7) (2019)	• Contaminants effects below threshold • Decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and off-shore activities.
GES Operational Objective (UNEP/MED WG473/7) (2019)	Effects of released contaminants are minimized.

<u>*Available data*</u>

435. The list of bibliographic studies on biomarkers used for the preparation of the 2023 MED QSR is sorted alphabetically by country as shown in Table 4.4.1.

436. Based on the literature search results it can be concluded that a comparison among the studies is hard or mostly impossible. This is due to the use of different biomarkers, with different biota species, using different tissues, and different methodologies. Moreover, as found in the 2017 QSR, there are confounding factors that hinders environmental status assessment such as species, gender, maturation status, season and temperature. In addition, an inherent bias exists in publications towards studies showing an effect. Authors and journals do not usually publish studies showing lack of effect or response.

Table 4.4.1: Studies on biomarkers in the Mediterranean Sea since 2016 reviewed in present assessment of CI 18. The list is sorted alphabetically by country.

Reference	**Country**	**Sub-region**	**Sampling year**	**Taxa**	**Species**	**Organ/tissue**	**Stressor**	**Biomarker**
Kaddour et al. 2021	Algeria	WMS	2019-2020	Fish	*Mullus barbatus*	blood	non specific	MN, NRRT
Amamra et al. 2019	Algeria	WMS	2016	mollusc	*Donax trunculus*	gonad, mantle, digestive gland	non specific	AChE, GST, MDA
Benaissa et al. 2020	Algeria	WMS	2016	mollusc	*Patella rustica*	Soft tissue	desalination brine	AChE, CAT, SOD, GR, GPx, GST, LPO, Genotox
Laouati et al. 2021	Algeria	WMS	2017	mollusc	*Perna perna*	digestive gland and gills	non specific, TM	AChE, CAT, GSH, GST, MDA
Gabr et al. 2020	Egypt	AEL	2018-2019	mollusc	*Ruditapes decussatus*	soft tissue	TM	AChE, SOD, GPx, MDA

Reference	Country	Sub-region	Sampling year	Taxa	Species	Organ/tissue	Stressor	Biomarker
Salvaggio et al. 2019	Italy	FAO Area 37	not reported	Fish	*Lepidopus caudatus*	liver, gonads	Microplastic, TM	VTG, MT
Frapiccini et al. 2021	Italy	ADR	2019	Fish	*Mullus barbatus*	muscle	PAH	CAT,SOD,GST,LPO
Chenet et al. 2021	Italy	CEN	2018	fish	*Trachurus trachurus*	liver	plastic	VTG, MT
Morroni et al. 2020	Italy	WMS	2017	Fish	*Diplodus vulgaris*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Morroni et al. 2020	Italy	WMS	2017	Fish	*Mullus barbatus*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Morroni et al. 2020	Italy	WMS	2017	Fish	*Pagellus erythrinus*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Parrino et al. 2020	Italy	WMS	not reported	Fish	*Parablennius Sanguinolentus*	Brain and blood	pesticides	AChE, BChE
Morroni et al. 2020	Italy	WMS	2017	mollusc	*Mytilus galloprovincialis*	various	PAH, TM	AChE, MT, MN, LMS, EROD
Capo et al. 2022	Spain	WMS	2019	Fish	*Sparus aurata*	blood, plasma, liver	microplastic, plasticizers	CAT,SOD,GRd,GPx, MPO, GST, MDA, EROD, BFCOD, CE
Solomando et al. 2022	Spain	WMS	2020	Fish	*S. dumerili*	liver	microplastic	CAT,SOD,GST, EROD, MDA
Rios-Fuster et al. 2022	Spain	WMS	2019	mollusc	*Mytilus galloprovincialis*	Soft tissue	Anthrop. Particles, bisphenols, phthalate	CAT,SOD,GRd,GPx, GST, TES, GLY, CE, LPO, CARB, GSH
Capo et al 2021	Spain	WMS	not reported	mollusc	*Mytilus galloprovincialis*	gills	microplastic	CAT,SOD,GRd,GPx, GST,MDA, ROS
Rodríguez-Romeu et al., 2022	Spain	WMS	2019	Fish	*Engraulis encrasicolus*	Muscle and liver	Anthopogenic items ingestion	AChE, LDH, CS, CE, CAT, GST, EROD
Mansour et al. 2021	Tunisia	CEN	2016	mollusc	*Ruditapes decussatus*	Soft tissue	hydrocarbons	CAT,SOD,GRd,MDA, AChE
Zaidi et al. 2022	Tunisia	CEN	2018	mollusc	*Patella caerulea*	soft tissue	TM	CAT,SOD,GPx,GST,MDA
Ghribi et al. 2020	Tunisia	CEN	2017 mesocosm	mollusc	*Mytillus spp*	hemolymph, gills, and digestive gland	non specific PAH, TM	CAT, GPx, GST, AChE
Missawi et al. 2020	Tunisia#	CEN	2018	Seaworm	*Hediste diversicolor*	whole (gut cleaned)	Microplastic	CAT,GST,MDA, AChE

Reference	Country	Sub-region	Sampling year	Taxa	Species	Organ/tissue	Stressor	Biomarker
Zitouni et al. 2020	Tunisia*	WMS	2018	Fish	*Serranus scriba*	gastrointestinal tract	Microplastic	CAT,GST,MDA, AChE,MT
Telahigue et al. 2022	Tunisia	WMS	2020-2021	mollusc	*Flexopecten glaber*	gills, digestive gland	TM	CAT,SOD,GPx,GSH, MT, MDA
Bouhedi et al 2021	Tunisia	WMS	not reported	polychaete	*Perinereis cultrifera*	whole body	TM	CAT,GST, AChE, MT, GSH, TBARS
Uluturhan et al. 2019	Türkiye	AEL	2015	mollusc	*Mytilus galloprovincialis*	Hepatopancreas	TM, Pesticides	CAT,SOD,GPx, AChE
Uluturhan et al. 2019	Türkiye	AEL	2015	mollusc	*Tapes decussatus*	Hepatopancreas	TM, Pesticides	CAT,SOD,GPx,AChE
Dogan et al, 2022	Türkiye	AEL	2021	Fish	*Mullus barbatus*	muscle, liver	TM	CAT, MDA
Dogan et al, 2022	Türkiye	AEL	2021	Fish	*Boops boops*	muscle, liver	TM	CAT, MDA
Dogan et al, 2022	Türkiye	AEL	2021	Fish	*Trachurus trachurus*	muscle, liver	TM	CAT, MDA

#data related to the WMS as well; * data related to the CEN as well.

Biomarkers Abbreviations: AChE-Acetylcholinesterase, BChE-Butyrylcholinesterase, BFCOD-7-benzyloxy-4-[trifluoromethyl]-coumarin-O-debenzyloxylase, CAT-Catalase, CE-Carboxylesterase, CS- Citrate synthase,EROD-Ethoxyresorufin-O21 deethylase, ETS-Electron Transport System, GLY-Glycogen, GPx-Glutathione peroxidase, GRd-Glutathione reductase, GSH- Glutathione, GST-Glutathione-S-transferase, LDH-Lactate dehydrogenase, LMS-Lysosomal Membrane Stability, LPO-Lipid peroxidation, MDA-Malondialdehyde, MN-Micronucleus Assay, MT-Metallothionein, NRTT-Neutral red retention time, SOD-Superoxide dismutase, SoS-Stress on Stress,VTG-Vitellogenin

Results of the IMAP Environmental Assessment of CI 18 in the Mediterranean region.

437. Due to absence of any data reporting by the CPs, data for present assessment were retrieved from the scientific literature. The studies surveyed do not include the parameters assessed in the 2017 MED QSR in mussel. The only exception is Morroni et al., 2020 that measured LMS, AChE and MN in *M. galloprovincialis* but not in the same organs except for MN that was measured in haemocytes with a value of 0.3 permil in reference area and a maximal value of 1.3 permil. The maximal value is slightly higher than 1 permil, the MED BAC adopted in Decision IG.23/6. Ghribi et al., 2020 and Uluturhan et al, 2019 reported AChE in haemolymph and hepatopancreas, respectively and not in gills.

438. Given GES assessment was not possible for CI 18 within the preparation of the 2023 MED QSR, the regional overall assessment findings were provided for the Mediterranean as presented here-below (UNEP/MAP – MED POL, 2023). Instead of providing GES /non-GES classification, the assessment for IMAP CI 18 was based on the determination of biomarkers that were affected by contamination.

439. A summary of reviewed studies is sorted by sub-regions and countries. The biomarkers that were affected by contamination are marked in red, those that were not affected are marked in green, while inconclusive results are marked in blue. Moreover, the biomarkers included in the DDs and DSs are highlighted in yellow, but with no differentiation among species or tissues studied.

a) AEL sub-region (Egypt, Türkiye)

440. **Egypt.** One study was reviewed. The effect of TM was studied in the mussel *Ruditapes decussatus* collected from Alexandrian Port and Port Said (Gabr et al. 2020). The concentrations of metals were higher in samples from the Alexandrian Port (Site I). Malondialdehyde (MDA) and SOD were higher in samples from Site I while GPx, Total protein and AChE were lower. The reported values in this study are considered as basic data to monitor of the anthropogenic influence on the coastal environment.

441. **Türkiye.** Two studies were reviewed for Türkiye: one from 2015 and one from 2022[50]. The effect of TM and pesticides was studied on the molluscs *Mytilus galloprovincialis* and *T. decussatus* collected from Homa Lagoon (Aegean Sea). The study showed marked differences on the biomarkers (CAT, SOD, GPx, and AChE) but the differences were mainly attributed to seasonal variations and to differences among the two species (Uluturhan et al. 2019). The effect of TM was also studied in the fish *M. barbatus, B. boops and T. trachurus* collected along the coast of Türkiye in the Levantine and the Aegean Seas. Correlations were found between CAT and MDA and some of the trace metals measured in the fish specimens.

b) ADR sub-region (Italy)

442. **Italy**. One study reported the effect of PAHs in the fish *Mullus barbatus* collected in the northern Adriatic (Frapiccini et al. 2020). The expressions of CAT and GST in *M. barbatus* were dependent on the season, lower in the winter and higher in the summer. SOD expression did not depend on the season. LPO was higher in the winter. CAT showed a significant negative correlation with total PAH concentrations, especially total LMW-PAH, in individuals collected during winter. Both GST and SOD did not show any significant correlation with PAH levels.

c) CEN sub-region (Tunisia, Italy)

443. Seven studies were reviewed for Tunisia: 2 from the WMS (Section 3.1.1), 3 from the CEN (Section 3.1.2) and 2 with data from both the WMS and the CEN (Section 3.1.1). In the CEN, one mesocosm experiment was performed in *Mytilus spp*. exposed to sediment contaminated by PAH and TM collected from the Zarzis area (Ghribi et al. 2020), while the effects of hydrocarbons were studied in the mollusc *Ruditapes decussatus* collected from the southern Lagoon of Tunis (Mansour et al. 2021). The effect of TM on the mollusc *Patella caerulea* was studied in specimens collected from 4 sites in the CEN (Zaidi et al. 2022). Two studies with data from the two sub-regions: WMS and CEN were summarized in Section 3.1.1.

444. *Mytilus spp* exposed to contaminated sediments in a mesocosm experiment presented the highest values of the tested oxidative stress biomarkers (CAT, GST, GPx) and a significant inhibition of AChE activity in comparison with the unpolluted reference site.

445. Hydrocarbons were found to affect the biomarkers CAT, GR, SOD, MDA and AChE activities in *Ruditapes decussatus.*

446. SOD and GPx activities measured in *P. caerulea* were different among sites (higher in more affected stations), while CAT was similar on all four stations. MDA was inducted but no differences were found among the sites.

447. **Italy**. In the CEN, the effect of plastic ingestion was studies in the fish *Trachurus trachurus* collected for the Sicily straits (Chenet et al. 2021).

448. Vitellogenin was highly expressed in *T. trachurus* females as expected, there is also a significant expression of the VTG gene in 60% of the males analyzed, from both sampling sites. Moreover, females in Lampedusa island showed a lower expression of vitellogenin than in Mazara del Vallo (with one female sample, TT54, not expressing VTG at all). The endocrine disruption represented by the alteration of VTG expression in specimens observed in this work can be caused by

[50] Submitted to Research Square, not peer reviewed by a scientific journal

microplastic ingestion, as well as by the interactions between the marine organisms and the wide variety of endocrine-disrupting chemicals possibly present in seawater.

d) WMS sub-region (Algeria, Spain, Tunisia, Italy)

449. **Algeria.** Four studies reviewed for Algeria studied the effects of non-specific stressor in the mollusc *Donax trunculus* from Annaba Bay (Amamra et al. 2019) , in the fish *Mullus barbatus* along the Algerian west coast (Kristel, Oran, Ghazaouet) (Kaddour et al. 2021), on the mollusc *Perna perna* transplanted to the Gulf of Annaba initianorth-eastern coast) (Laouati et al. 2021) and on the mollusc *Patella rustica* affected by the brine of the Bousfer desalination plant in Oran Bay (Benaissa et al. 2020).

450. *Donax trunculus* specimens showed a significant inhibition of AChE and induction of GST and MDA in individuals of Sidi Salem and Echatt as compared to El Battah with significant effects of both site and season. The effects were more pronounced during summer and spring compared to the other seasons. In addition, the comparison between tissues revealed a more marked response in gonad than mantle and digestive gland.

451. In *M. barbatus*, a significant increase in the frequency of micronuclei (MN) occurrence in the summer period correlated with significantly shorter NRRT. In addition, the erythrocytes of *M. barbatus populations* from polluted areas presented statistically higher MN frequencies and shorter NRRT than those of the reference site.

452. GSH decreased in the gills and digestive glands of *P. perna* specimens transplanted to two of the sites affected by anthropogenic input while GST and CAT activities showed no significant variation. The MDA content in the mussel digestive glands, but not in the gills, increased significantly after the deployment period in the three caging sites, and were significantly different among the 3 sites. AChE activity was significantly inhibited registered in the gills of mussels from the 3 sites and in the digestive glands from one site.

453. A multibiomarker approach (oxidative stress, biotransformation enzyme, lipid peroxidation, neurotoxicity and genotoxicity) were applied in the soft tissue of *P. rustica* . This biomonitoring confirmed the negative impact of brine discharges of the desalination plant, with samples collected close to the outfall more affected. by all the environmental disturbances than ones from the other sites. CAT, TGPx, GR, GST, CSP-3like activities were increased in samples from the outfall. AChE was lower however not significantly different from samples collected from the reference site. Genotoxic effect revealed by ADN and lipid damages.

454. **Spain.** Five studies were reviewed for Spain: four studies studied the effect of microplastic ingestion and of plasticizers on the biomarker responses, while one studied the effect of anthropogenic items ingestion. Three studies were conducted in the Integrated Multi-Trophic Aquaculture cages in Palma de Majorca, where specimens of the mussel *Mytilus galloprovincialis* and of the fish *Sparus aurata* were transplanted to and analyzed at time 0, after 60 days (T_{60}) and after 120 days (T_{120}) of exposure (Capó et al. 2022, Capo et al. 2021, Rios-Fuster et al. 2022). One study was performed with *S. dumerili* collected around the Balearic Islands (Solomando et al. 2022). Anthropogenic items ingestion was studied in *E. encrasicolus* collected off Catalunia (Rodríguez-Romeu et al. 2022).

455. No effects of time were observed in CAT, SOD, and GRd activities *M. galloprovincialis*, but they were significantly higher in specimens sampled from the cages than in specimens from the controls. GST activity did not change with time, and it increased significantly only in samples for the cages at T_{60}. In T_{120} activity was higher in the cages only if compared to one of the control sites. GPx activity was modulated by both sampling site and time: higher activities in specimens from the cages at T_{120}. MDA was higher in samples from the cages compared to the controls at T60. In a different study with *M. galloprovincialis* higher expressions were observed in the biomarkers CAT, SOD, GPx and LPO in specimens from the aquaculture cages. Those could be triggered by the presence of bisphenol but also by other possible contaminant inputs from the aquaculture.

456. MDA increased throughout the study both in liver and blood cells of *S. aurata* but with a progressive decrease in plasma. EROD, BFCOD and CE, showed a comparable decrease at T_{60} with a

slight recovery at T_{120}. In contrast, GST activity was significantly enhanced at T_{60} compared to the other sampling stages.

457. SOD, CAT, and GST activity were significantly higher in *S. dumerili* with higher microplastic (MP) load, while no significant differences were observed for MDA, and EROD enzyme activity.

458. AChE, CAT and GST were lower in *E. encrasicolus* collected off Barcelona, compared to specimens collected Blanes and Tarragona; Terragona LDH, CE and EROD were higher in Terragona than in the other two locations; Blanes CS was higher than in Tarragona. These differences could not be correlated with any potential stressors nor with fish size Catalunia (Rodríguez-Romeu et al. 2022).

459. **Italy.** Five studies were reviewed for Italy: 2 from the WMS, 1 from FAO zone 37 (not further specified), 1 from the CEN (Section 3.1.2), 1 from the ADR (Section 3.1.3). In the WMS, the effect of pesticides were studied in the fish *Parablennius sanguinolentus* from the port of Bagnara (western Calabria) (Parrino et al. 2020), and the effect of TM and PAHs on mollusc (*Mytilus galloprovincialis*) and fish (*Mullus barbatus, Pagellus erythrinus* and *Diplodus vulgaris)*from the bay of Pozzuoli (Naples)(Morroni et al. 2020). Microplastics and TM effects were studied on the fish *Lepidopus caudatus* collected from FAO area 37 (area not further specified) (Salvaggio et al. 2019).

460. AChE activity in the brain and BChE activity in blood were significantly inhibited in specimens of *P. sanguinolentus* from the affected port area, by 23.5 and 72.0%, respectively. The esterase inhibition was primarily due to carbamate and organophosphorus insecticides presence.

461. In the Bay of Pozzuoli, the effect of pollution varied by species and biomarkers. In *M. galloprovincialis*, there was a decreased LMS and increased MN at two sites compared to organisms from other areas while no variations were observed for the AChE in haemolymph, nor for MT in digestive gland of mussels from various sites. AChE activity was not affected in *M. barbatus* sampled in the industrial area while a decrease of this biomarker AChE was observed in *P. erythrinus* and *D. vulgaris*. The EROD enzymatic activity was significantly induced in *M. barbatus* and *P. erythrinus* sampled in the industrial area compared to specimens from the reference site, while the cytochrome P450 biotransformation pathway was unaffected in *D. vulgaris*. At the same time, all the fish species exhibited higher levels of aromatic metabolites, particularly B[a]P-like and pyrene-like, in organisms sampled in the industrial compared to reference area. MN increased in gills of *M. barbatus* from the industrial area.

462. Immunohistochemical analysis for anti-metallothionein 1 antibody in *L. caudatus* showed a strong positivity of liver cells, both in females and males, showing a strong stress that activated a cell detoxification system. The immunohistochemical analysis for the anti-vitellogenin antibody showed in females a strong positivity both in the liver cells, and in the gonads, as expected. The analysis of the liver and gonadal preparations of the male specimens was found to be always negative except for one specimen.

463. **Tunisia.** Seven studies were reviewed for Tunisia: 2 from the WMS, 3 from the CEN (Section 3.1.2) and 2 with data from both the WMS and the CEN. In the WMS, the effect of TM was studied in the mollusc *Flexopecten glaber* collected from the Bizerte Lagoon (Telahigue et al. 2022) and on the polychaete *Perinereis cultrifera* collected from the port of Tades and the Punic port of Carthage (Bouhedi et al. 2021). The following 2 studies have data from the two sub-regions: WMS and CEN. The effect of microplastic ingestion was studied in the fish *Serranus scriba* collected from 6 sites along the Tunisian coast (Zitouni et al. 2020) and on the seaworm *Hediste diversicolor* collected from 8 sites along the Tunisian coast (Missawi et al. 2020).

464. The distribution of most analyzed metals in *F. glaber* tissues varied significantly between sites, seasons, and organs. The highest levels were recorded at the polluted site during the warm period. Moreover, the digestive gland was found to accumulate greater concentrations of TM than the gills. The biomarkers (MDA, GSH, GPx, SOD, CAT) in gills were higher in the polluted site while MT was not affected. In the digestive gland, only CAT and MDA showed an increase activity in the polluted site.

465. Higher level of thiobarbituric acid were found in *P. cultrifera specimens* from polluted site. In addition, CAT, GST, SOD, glutathione and MT were enhanced and AChE activities decreased

in *specimens from* the contaminated site compared to those from the reference (or less contaminated site).

466. Biomarkers of oxidative stress (MT, CAT, GST, MDA) and neurotoxicity (AChE) responses in *S. scriba* were dependent on site and on the size of the microplastic. High content of microplastic in the gastrointestinal track increased MT levels and GST activity. CAT activity and MDA accumulation were positively related with the medium size class MP A significant negative correlation was found between AChE activity and the small size class of microplastic (MP). The study could not rule out some influence of other pollutants that may be present in some of the sites on biomarker response.

467. In the seaworm *Hediste diversicolor*, responses increased with increased microplastic tissue concentration, in particular CAT but also MDA. A decrease of GST activity was reported in the same sites. AChE was significantly inhibited indicating neurotoxicity.

4.5. Assessment of Common Indicator 19[51]

4.6. Assessment of IMAP Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	**Countries reporting IMAP CI-17 data:** Albania, Croatia, Cyprus, France, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Spain, Türkiye. **Scientific literature**. Algeria, Croatia, Egypt, France, Greece, Italy, Lebanon, Morocco, Spain, Tunisia, Türkiye
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood
GES Definition (UNEP/MED WG473/7) (2019)	Concentrations of contaminants are within the regulatory limits for consumption by humans
GES Targets (UNEP/MED WG473/7) (2019)	Concentrations of contaminants are within the regulatory limits set by legislation
GES Operational Objective (UNEP/MED WG473/7) (2019)	Levels of known harmful contaminants in major types of seafood do not exceed established standards

<u>*Available data.*</u>

468. The two groups of data were collected i.e. i) data reported to IMAP - IS for CI-17 contaminants in biota, and ii) data from scientific literature. The relevant data from IMAP-IS consisted of the concentrations of trace metals (Cd, Hg and Pb) in fish and molluscs; PAHs in molluscs and PCBs in fish and molluscs. It should be emphasized that these data were collected within IMAP monitoring programs to assess the status of the marine environment and not to protect human health.

469. CI 17 data available from IMAP-IS for the monitoring species (M. *galloprovincialis and M. barbatus*) are shown in Table 4.6.1.

[51] This section is under preparation

Table 4.6.1. Number of data points extracted from CI-17 database, relevant for CI-20 Assessment. MG – Mytilus galloprovincialis; MB- Mullus barbatus. Table is sorted by species and alphabetical order of CPs.

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Albania	2020	MG	2	2	2			2
Croatia	2019-2020	MG	37	35	37			19
France	2015, 2017-2018	MG	50	50	50	25	25	23
Italy	2015-2019	MG	33	170	33		53	
Montenegro	2018-2020	MG	28	28	28	21	21	21
Morocco	2019-2021	MG	12	12	12	6	6	
Slovenia	2016-2021	MG	21	21	15	12	12	
Spain	2015-2017,2019	MG	70	70	70	42	42	40
Croatia	2019-2020	MB	11	10	11			
Cyprus	2020-2021	MB	14	14	0	12	12	12
Israel	2015, 2018-2020	MB	58	60				
Lebanon	2019	MB	14	14	14			
Malta	2017, 2019	MB	5	5	5			
Montenegro	2018	MB	8	8	8			
Türkiye	2015	MB	25	25	25		8	

470. Relevant data for additional species other than the mandatory species reported to IMAP-IS were available as presented here-below under assessment of data reported for the mandatory monitoring species.

471. The literature search on seafood quality in the Mediterranean Sea focused on the studies that reported data from 2016/2017 onward, emphasizing contaminants that are regulated in the EU (UNEP/MAP – MED POL, 2023). Previous studies have been used in the preparation of the 2017 MED QSR.

472. The bibliographic studies reported concentrations of contaminants and compared them to EU regulation while some also addressed national regulation as well as international regulations or advisories (De Witte et al. 2022). Most of the studies provided also risk assessments to human health from consumption of the seafood by calculating the estimated daily intake (EDI), target hazard quotient (THQ), total risk (HI), Cancer risk, among others.

473. This emphasizes the fact that the risk to human health (and hence GES- non GES statuses) should not be evaluated based on concentration of a single contaminant but evaluated together with other factors such as synergy with other contaminants, temporal and spatial scales.

474. Another point to make is that recent literature emphasizes the connection between seafood safety and quality and the presence of microplastics in the marine environment (i.e.Wakkaf et al. 2020 among many others). Human health may be impacted either by consuming seafood with microplastic content, or seafood with contaminants that were leached from the microplastic to the organism. This sets an interrelation of CI 20 with CI 23 and should be further pursued.

475. Table 4.5.2 provides a summary of the studies published in the peer-reviewed literature. Thirty-six studies from 11 CPs were found relevant for the present work, with 1-4 studies each, except for Italy that had 14 studies. Most (25) reported concentrations of trace metals (TM) and 12 on organic

contaminants (PAHs, PCBs, PBDEs, PCDD/Fs). Concentrations in fish were reported in 26 studies and concentrations in molluscs were reported in 17 studies.

Table 4.6.2 The number of studies, per country, on seafood quality and safety in the Mediterranean which findings were used to support present assessment.

Country	Total Number of studies	Number of studies reporting on:		Number of studies reporting on:		
		Trace metals	Organic contaminants	Fish	Mollusc	Other (crustaceans, cephalopods)
Algeria	3	3	0	3	0	0
Croatia	2	2	0	2	0	0
Egypt	1	0	1	1*	1	1
France	1	0	1	1	0	0
Greece	2	2	0	2	0	0
Italy	14	9	7	9	9	3
Lebanon	3	3	0	2	2	2
Morocco	3	3	0	1	2	0
Spain	1	1	0	1	0	0
Tunisia	2	0	2	2	1	1
Türkiye	4#	2	1	2	2	1

*fresh water fish; #one study on radioactivity as contaminants in fish.

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476. Given the complete lack of data reported for CI 20, the environmental assessment of CI 20 was performed as explained in Section 2, by using the following two approaches: i) assessment of the status based on data reported to IMAP-IS for CI 17 contaminants in biota up to 31st, October 2022, the cutoff date for data reporting to be used in the 2023 MED QSR, using the EU concentration limits for regulated contaminants(UNEP/MAP - MED POL, 2023) , and ii) assessment of present status based on bibliographic studies, following the same approach applied for preparation of the 2017 MED QSR, however by using newer available scientific literature.

a) Assessment of the status based on data reported to IMAP-IS for contaminants in biota (CI 17)

477. The data reported to IMAP-IS for CI-17 was investigated and the relevant data extracted and used for present initial marine environment assessment for IMAP CI 20. The relevant data consisted of the concentrations of trace metals (Cd, Hg and Pb) in fish and molluscs; PAHs in molluscs and PCBs in fish and molluscs. It should be emphasized that these data were collected within IMAP monitoring programs to assess the status of the marine environment and not to protect human health.

a.1. Assessment of data reported for the mandatory monitoring species Mytilus galloprovincialis (MG) and Mullus barbatus (MB)

478. The available data for the mandatory species *M. galloprovincialis* and *M. barbatus* are summarized in Table 5.5.1, Section 5.5, along with the number of data points that exceeded the concentration limits for human consumption (UNEP/MAP – MED POL, 2023).

479. Most of the measured concentrations were below the concentration limits for the regulated contaminants in the EU, with a few exceptions in Cyprus, Montenegro, and Spain. The maximal percentage of values above the EU criteria for one specific contaminant was low (14%).

a.2. Assessment of data reported to IMAP-IS for other species

480. The biota files from the IMAP-IS database were screened again for species other than the mandatory monitoring species, *M. galloprovincialis* and *M. barbatus*, for CI 17. Additional species were reported as shown here-below.

481. **Cyprus (2020-2021).** Cd and Hg were measured in the muscle of the fish *Boops boops* (n=13), *Thynnus alalunga* (n=52) and *Merluccius merluccius* (n=1). All the concentrations were below the concentration limits for the regulated contaminants in the EU, except for Hg in 6 samples of *T. alalunga*. Σ_4 PAHs and Σ_6 PCBs were reported for *Boops boops* (n=10) and *T. alalunga* (n=15). All concentrations were below detection limit and for Σ_6 PCBs also below the concentration limits in the EU. No criteria were given for PAHs in fish.

482. **Croatia (2019)**. Cd and Pb were measured in the muscle of the fish *Merluccius merluccius* (n=3), *Mullus surmuletus* (n=1), *Pagellus erythrinus* (n=3), *Sparus aurata* (n=9). All concentrations were below the concentration limits for the regulated contaminants in the EU.

483. **France (2017)**[52]. Cd, Hg, Pb (n=6 each) and Σ_4 PAHs and Σ_6 PCBs (n=4 and n=2, respectively) were measured in the mollusc (bivalve) *Crassostrea gigas* and Cd, Hg, Pb were measured in 7 samples of the mollusc (bivalve) *Venerupis decussata*. All concentrations were below the concentration limits for the regulated contaminants in the EU.

484. **Israel (2015, 2018, 2020).** Cd and Hg were measured in 6 samples of the mollusc (bivalve) *Donax trunculus*, and Cd and Hg were measured in 26 samples of the mollusc (bivalve) *Mactra corallina*. All concentrations were below the concentration limits for the regulated contaminants in the EU.

485. **Lebanon (2019).** Cd, Hg, Pb (n=11 each) and Σ_6 PCBs (n=3) were measured in the fish *Diplodus sargus* and Cd, Hg, Pb (n=15 each) and Σ_6 PCBs (n=13) were measured in the fish *Euthynnus alletratus*. All concentrations were below the concentration limits for the regulated contaminants in the EU.

486. **Malta (2017 and 2019).** Cd, Hg, Pb (n=4 each), dioxin like PCBs and Total dioxins and furans (n=1 each) were measured in the fish *Merluccius merluccius.* All concentrations were below the concentration limits for the regulated contaminants in the EU.

487. **Morocco (2019-2021).** Cd, Hg, Pb (n=30 each) were measured in the mollusks *Callista chione* (n=30) and petite praire (n=6). All concentrations were below the concentration limits for the regulated contaminants in the EU. Σ_4 PAHs were reported for *C. chione* (n=15) and petite praire (n=3). All concentrations were below the concentration limits for the regulated contaminants in the EU.

b) Assessment of the status based on bibliographic studies

488. In the context of CI 20, to protect human health, trace metals in fish were reported for many species across the Mediterranean countries: Algeria, Croatia, Greece, Italy, Lebanon, Morocco, Spain and Türkiye. Trace metals in molluscs were reported in various species from Italy, Lebanon, Morocco and Türkiye. Organic contaminants in fish were reported for various species from France, Italy and Tunisia, and in molluscs for Egypt, France, Italy, Tunisia and Türkiye. Trace metals and organic contaminants were reported also for some crustaceans and cephalopod species. Information on consumers` health risk was available for Algeria, Croatia, Italy, Tunisia and Türkiye, only. The literature review (UNEP/MAP – MED POL, 2023)is summarized here-below and in Table 4.5.3 and Figure 5.5.1.

489. **Algeria (WMS):** Cd, Hg, Cu were reported in *Sardina pilchardus* and in M*ullus barbatus* collected from the Algerian coast (2017-2018). Concentrations were below the concentration limits for the regulated contaminants in the EU, except concentrations of Cd in some specimens from the bay of Algiers that were higher than the EU regulatory threshold. The average Pb concentrations did not exceed the regulatory value, although some specimens had concentrations higher than the threshold. Consumption of *S. pilchardus* from Algerian coast was not likely to have adverse effect on human

[52] Data from EMODNet.

health and a few risks were assigned to the consumption of contaminated *M. barbatus* (Hamida et al. 2018, Aissioui et al. 2021, Aissioui et al. 2022).

490. **Croatia (ADR):** Cd, Hg and Pb were reported for fish from 11 species[53] purchased in 2016 from supermarkets located in different Croatian cities. Hg and Pb concentrations were below the concentration limits for the regulated contaminants in the EU. Mean Cd levels in bluefin tuna exceeded the EU limit. Consumer health risk calculated from the dietary intakes for Cd was low, with exception of bluefin tuna. For Hg, frequent consumption of European sea bass, carp and bluefin tuna over a long period may have toxicological consequences for consumers. In a different study in 2016, the concentration of Hg did not exceed EU regulations in European pilchard and European anchovy (Bilandžić et al. 2018, Sulimanec Grgec et al. 2020).

491. **Egypt (AEL):** Persistent organic pollutants were reported in the mollusc *Donax trunculus* at the Rosetta Nile branch estuary. PCBs levels were well below tolerable average residue levels established by FDA and FAO/WHO for human fish consumption (Abbassy 2018).

492. **France (WMS):** Persistent organic pollutants (POP[54]s) were evaluated in six fish and two cephalopods species from an impacted area in NW Mediterranean Sea (Rhone river estuary vicinity). For Atlantic bonito (*Sarda sarda*) and chub mackerel (*Scomber colias*), the estimated weekly intakes of dioxin-like POPs for humans overpassed the EU tolerable weekly intake. Concentrations of nondioxin-like PCBs in *S. sarda* were above the EU maximum levels in foodstuffs, pointing to a risk (Castro-Jiménez et al. 2021).

493. **Greece (AEL)**: Cd, Hg and Pb were reported in 4 fish species[55]. Concentrations in *S. aurata* and *D. labrax* were below the concentration limits for the regulated contaminants in the EU. In sardine and anchovy, nutritional benefits seem to outweigh the potential risks arising from fish metal content (Renieri et al. 2019, Sofoulaki et al. 2019).

494. **Italy (ADR, CEN, WMS) (TM in fish and mussel):** Hg, Cd, Pb were determined in 160 specimens of fish belonging to sixteen species collected in 2018 from commercial centers of South Italy. The concentrations were below the EU regulation, except for Cd in bluefin tuna, which exceeded the tolerable value. The estimated hazard quotient of Hg indicated a high probability of experiencing non-carcinogenic health risks (Storelli et al. 2020). Hg was measured in 42 commercial fish species caught off the Central Adriatic and Tyrrhenian coasts of Italy and in 6 aquaculture species. Hg levels exceeding the EC regulation limits were found in large-size specimens of high trophic-level pelagic and demersal species. An estimation of the human intake of mercury associated to the consumption of the studied fish and its comparison with the tolerable weekly intake is provided (Di Lena et al. 2017). Hg measured in European hake (*Merluccius merluccius*) caught in the northern and central Adriatic Sea were lower than the level set by EU regulations (Girolametti et al. 2022). Cd, Pd measured in the swordfish *Xiphias gladius* muscles were lower than the levels set by EU regulations. Hg in 32% of samples exceeded European maximum limits. Risk assessment indicates hazardous state concerning Hg (Di Bella et al. 2020).

495. Cd, Hg, Pb in *Mytilus galloprovincialis* did not exceed the maximum limits as established by EU regulation from the Gulf of Naples and Domitio littoral (2016-2019) nor in specimens from the Claich Lagoon (Sardinia, 2017), the Marche (2016-2017) nor in Sicily (2016) (Esposito et al. 2020, 2021; Cammilleri et al. 2020).

496. **Italy (ADR, CEN, WMS) (Organic contaminants in fish and mollusc).** PAHs were measured *Sardina pilchardus and Solea solea* caught in the Catania Gulf (Sicily, 2017) (Ferrante et al. 2018). EU criteria for PAH the protection of human health exist only for mollusc and not for fish. Polychlorinated dioxins and furans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (dl-PCBs)

[53] Hake (Merluccius merluccius, n=7), Atlantic mackerel (Scomber scombrus, n=7), cod (Gadus morhua, n=7), chub mackerel (Scomber japonicas, n=7), fresh and canned sardine (Sardina pilchardus, n=7), European sea bass (Dicentrarchus labrax, n=13), gilthead sea bream (Sparus aurata, n=11), bluefin tuna (Thunnus thynnus, n=8), salmonbass (Argyrosomus regius, n=8), rainbow trout (Oncorhynchus mykiss, n=7) and carp (Cyprinus carpio, n=7).

[54] Polybrominated diphenyl ethers (PBDEs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), polychlorinated biphenyls (PCBs)

[55] Seabream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*) sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*)

measured in fish[56] were below the maximum limits set by the EC for human consumption (Barone et al. 2021). Σ_6 PCBs and dioxins and dioxin-like PCBs were lower than the values in the EU regulation in specimens of 3 edible fish species[57] samples in 2017 in the Northern Tyrrhenian Sea (Bartalini et al. 2020). PCDD/Fs, PCBs, measured in fish[58] from Taranto (2016) and PCDD/Fs and dl-PCBs) measured in fish[59] from Southern Italy (2019) were below the regulatory limits specified for these contaminants within the EU (Ceci et al. 2022, Barone et al. 2021). Σ_6 PCBs in in marine organisms[60] collected from the contaminated Augusta Bay (Southern Italy, 2017) showed variable concentrations with a mean value above EU regulation in 2 fish species. Benzo[*a*] Pyrene (BaP) in mussels exceed threshold limit of the EU regulation. No risk analysis was performed. (Traina et al. 2021).

497. PCBs, dioxins and PAHs in *Mytilus galloprovincialis,* farmed in the waters of the Gulf of Naples and Domitio littoral (2016 to 2019), did not exceed the maximum limits as established by EU regulation, except for PAHs in a localized are in the winter (Esposito et al. 2020). Concentrations of Benzo(a)pyrene (BaP) and Σ4PAHs[61] exceeded the limit reported in EC in the Regulation for the mollusk *Donax trunculus,* caught in the Catania Gulf (Sicily, 2017). Risk assessment indicated concern for the health of high frequency molluscs consumers (Ferrante et al. 2018). PCDD/Fs and dl-PCBs in seafood[62] from Southern Italy (2019) and in mussel from Taranto (2016) were below the maximum limits set by the EC for human consumption except for a single sample taken from a known specific contaminated site in Taranto (Barone et al. 2021; Ceci et al. 2022).

498. **Lebanon (AEL):** Pb, Cd, and Hg were determined in three fish species (*Siganus rivulatus, Lithognathus mormyrus* and *Etrumeus teres),* in shrimp (*Marsupenaeus japonicus*) and in bivalve (*Spondylus spinosus*) commonly consumed by the local population. Trace metals concentrations were found to be below the maximum levels set by the EU (Ghosn et al. 2019, 2020a, 2020b).

499. **Morocco (WMS):** Cd and Pb concentrations were measured in soft tissues of *M. galloprovincialis.* Concentrations did not exceed EU regulations (Azizi et al. 2018; 2021). Cd, Hg and Pb concentrations measured in the fish *Liza ramada* were also below the values set in the EU regulation (Mahjoub et al. 2021).

500. **Spain (WMS):** The concentrations of Pb, Cd and Hg measured in the highly migratory *Thunnus alalunga* and *Katsuwonus pelamis* were below the tolerable limits considered by EU regulation (Chanto-García et al. 2022)

501. **Tunisia (CEN):** Organic contaminants (PAHs, PCBs and pesticides) were measured in fish (*Sparus aurata* and *Sarpa salpa*) muscle tissue collected from five stations along the Tunisian coast between (2018-2019). Σ_6 PCBs for the fish were below the EC regulations. (Jebara et al. 2021). Concentrations of 21 legacy and emerging per- and polyfluorinated alkyl substances (PFAS)[63] were measured in in 9 marine species (3 fish, 2 crustaceans and 4 mollusks)[64] collected from Bizerte lagoon, Northern Tunisia (2018). Exposure to PFAS through seafood consumption indicates that it should not be of concern to the local consumers (Barhoumi et al. 2022).

502. **Türkiye (AEL):** Concentrations of Cd, Pb and Hg levels were measured in 9 fish, 1 mollusc and 1 shrimp species[65] from the Aegean and Levantine Seas. All the results were found compatible with the Turkish Food Codex and EU Regulation limits except for Cd in two samples from the

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[56] rosefish, Euro-pean hake, red mullet, common sole, bluefin tuna
[57] Sardine (*Sardina pilchardus*), anchovy (*Engraulis encrasicolus*) and bogue (*Boops boops*).
[58] hake, mullet, sea bream, bogue, red mullet mackerel, sardines and sand steenbras
[59] rosefish, Euro-pean hake, red mullet, common sole, bluefin tuna
[60] In 2017, mussels (*Mytilus galloprovincialis*) obtained from a commercial farm and transplanted to two sites in Augusta Bay and resampled after 5 weeks and 7 months. Fish: 96 specimens of finfish (*Sphyraena sphyraena, Trigla lucerna, Mullus barbatus, Pagellus* spp., *Diplodus* spp.) and shellfish (*Parapaeneus kerathurus* and *Sepia* spp.) were obtained through local fishermen
[61]benzo(a)pyrene (BaP), benz(a)anthracene (BaA), benzo(b)fluoranthene (BbF) and chrysene (CH)
[62] (cephalopods: common octopus, common cuttlefish, European squid), (shellfish: Mediterranean mussel, striped venus clam, common scallop), (crustaceans: red shrimp, spottail mantis shrimp, Norway lobster)
[63] PFASs are not addressed in the EU regulation
[64] Fish: European eel (*Anguilla anguilla*), common sole (*Solea solea*), sea bass (*Dicentrarchus labrax*); crab (*Carcinus maenas*), shrimp (*Penaeus notialis*), common cuttlefish (*Sepia officinalis*) gastropod mollusc- banded dye-murex (*Hexaplex trunculus*), clam (*Ruditapes decussatus*) and farmed mussel (*Mytilus galloprovincialis*)
[65] Fish: mullet (Mugil cephalus), shad (Alosafallax), hake (Merluccius merluccius), whitting (Merlangius euxmus), seabass (Dicentrarchus labrax), turbot (Scophthalmus maximus), red mullet (Mullus barbatus), blue fish (Pomatomus saltatrix), seabream (Sparus auratus). Mussel: (Mytilus galloprovincialis). Shrimp (Penaeus indicus)

Mediterranean Sea. As a whole, the seafood was found to be safe for human consumption (Kuplulu et al. 2018). Cd and Pb measured in the fish *Trachurus mediterraneus, Sparus aurata* and *Pegusa lascaris* were below the values set in the EU regulation (Karayakar et al. 2022). *Mytilus galloprovincialis,* were transplanted from a clean site to the 3 sites in Nemrut Bay, known to be impacted by of industrial activities. Benzo(a)pyrene and Σ_4 PAHs levels in the mussels from the clean site were below the EU regulations while in the transplanted mussels PAHs were higher than the concentrations in the EU regulation in certain occasions. The results suggest that mussels were unsafe for human consumption during the time of the experiment (Kucuksezgin et al. 2020).

503. **Türkiye (AEL):** Specific natural radionuclide (^{226}Ra, ^{232}Th and ^{40}K) concentrations were measured in wild and farmed European seabass collected from the Mediterranean coast of Türkiye (AEL) in 2018. From the radiological point of view, the radioactivity doses measured and the consumption of both wild and farmed seabass from the Mediterranean coast of Türkiye do not pose any risk to human health (Ozmen and Yilmaz 2020).

Table 4.6.3. Summary of the findings from the scientific literature (UNEP/MAP – MED POL, 2023), used to support present assessment, arranged alphabetically by country. The findings of some of the studies were summarized in more than one row, to allow for the separation of taxa (i.e. fish from mollusc) and contaminants (trace metals from organics). It includes sum of 4 PAHs (benzo(a)pyrene (BaP), benz(a)anthracene (BaA), benzo(b)fluoranthene (BbF) and chrysene (CH) (Σ_4 PAHs); Benzo(a)Pyrene (B(a)P); sum of 6 non dioxin like PCBs (Σ_6 PCBs); sum of polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans (PCDD/Fs) and Σ (PCDD/Fs and dioxin like (dl) PCBs).

Cells in blue: values below EU criteria; cells in green: values above EU criteria but no health risk detected; cells in yellow: values above EU criteria, risk analysis was not reported; cells in red: above EU criteria with risk to human health.

Country	**Sampling Year**	**Species**	**Cd**	**Hg**	**Pb**	**Σ_4 PAHs**	**B(a)P**	**Σ_6 PCBs**	**PCDD/Fs**	**Σ (PCDD/F and dl PCBs)**
Algeria		sardines	√		√					
	2017-2018	*S. pilchardus*	√*	√	√					
	2017-2018	*M. barbatus*	√*	√	√*					
Croatia	2016	11 fish species	√#	√	√					
	2016	European pilchard, European anchovy	√							
Egypt	2017	*Donax trunculus*						√		
France^		Fish and cephalopods						√&	√&	
Greece	2017-2018	*Sparus aurata, Dicentrarchus labrax*	√	√	√					
		Sardina pilchardus, Engraulis encrasicolus	√	√	√					
Italy	2018	16 fish species	√#	√&	√					
		42 fish species		√&						
	2018-2019	*M. merluccius*		√						
	2017	*Xiphias gladius*	√	√&	√					
	2016-2019	*M. galloprovincialis*	√	√	√					
	2017	*M. galloprovincialis*	√	√	√					
	2016-2017	*M. galloprovincialis*	√	√	√					
	2016	*M. galloprovincialis*	√	√	√					
	2017	*S. pilchardus, S. solea*				√%				
	2019	5 fish species							√	√
	2017	3 fish species						√		√
	2016	7 fish species						√	√	

Country	**Sampling Year**	**Species**	**Cd**	**Hg**	**Pb**	**Σ$_4$ PAHs**	**B(a)P**	**Σ$_6$ PCBs**	**PCDD/Fs**	**Σ (PCDD/F and dl PCBs)**
	2019	5 fish species							√	√
^	2017	5 fish species						√+		
^	2017	*M. galloprovincialis* and other shellfish					√+	√+		
	2016-2019	*M. galloprovincialis*				√*		√		√
	2017	*Donax trunculus*				√&	√&			
	2019	Cephalopods, shellfish and crustaceans							√	√
	2019	*M. galloprovincialis*						√	√	
^	2017	*M. galloprovincialis*		√+		√	√+	√		
Lebanon	2016-2017	3 fish, 1 shrimp, 1 bivalve species	√	√	√					
	2017	1 bivalve, 1 shrimp species	√	√	√					
	2017	2 fish species	√	√	√					
Morocco	2016	*M. galloprovincialis*	√		√					
	2018	*M. galloprovincialis*	√							
	2018	*L. ramada*	√	√	√					
Spain		*T. alalunga, K. pelamis*	√	√	√					
Tunisia	2018-2019	*S. aurata*, S. *salpa*						√		
^^	2018	3 fish, 2 crustaceans and 4 mollusks species								
Türkiye	Not reported	9 fish, 1 mollusc and 1 shrimp species	√*	√	√					
^	2016-2017	*M. galloprovincialis*				√&	√&			
	2016-2017	3 fish species	√		√					

***** Specific sampling area or organism or size class, no health risk detected; # Cd exceeded EU regulation in bluefin tuna; & Risk for human consumption, specific species and size class; % No EU regulation concerning PAHs in fish, only in mollusc; + Exceeded EU regulation, specific organism or size class, no risk analysis performed; ^ Specimens collected from known impacted area; ^^Study measured organics not addressed in EU regulations, no risk to health detected.

4.7. Assessment of IMAP Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards

Geographical scale of the assessment	The Sub-regions within the Mediterranean region by using scientific literature sources
Contributing countries	Countries in EEA 2020 assessment (Albania, Croatia, Cyprus, France, Greece, Italy, Malta, Slovenia, Spain), and, from IMAP-IS, Bosnia and Herzegovina, Israel, Lebanon, Montenegro, Morocco
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO9. Contaminants cause no significant impact on coastal and marine ecosystems and human health
IMAP Common Indicator	CI21. Percentage of intestinal enterococci concentration measurements within established standards
GES Definition (UNEP/MED WG473/7) (2019)	Concentrations of intestinal enterococci are within established standards
GES Targets (UNEP/MED WG473/7) (2019)	Increasing trend in the percentage of intestinal enterococci concentration measurements within established standards
GES Operational Objective (UNEP/MED WG473/7) (2019)	Water quality in bathing waters and other recreational areas does not undermine human health

Available data

504. In the 2017 MED QSR, it was recommended to prepare the future assessments of IMAP CI 21 based on the statistics from datasets submitted by national authorities or/and the corresponding agencies. However, up to the end of March 2022, only a few data sets were reported to the IMAP-IS. Those are presented in Table 4.7.1.

Table 4.7.1. Available data for IMAP CI 21 in IMAP-IS starting from 2015 and up to October 31st, 2022, the cutoff date for data reporting for the 2023 MED QSR.

Source	IMAP file	Country	Sub-region	Year
IMAP-IS	403	Morocco	WMS	2018
IMAP-IS	404	Morocco	WMS	2019
IMAP-IS	616	Morocco	WMS	2020-2021
IMAP-IS	547-551	Spain	WMS	2017-2021
IMAP-IS	262	Bosnia and Herzegovina	ADR	2015-2020
IMAP-IS	385	Croatia	ADR	2016-2020
IMAP-IS	653	Croatia	ADR	2021
IMAP-IS	655	Croatia	ADR	2022
IMAP-IS	#	Montenegro	ADR	2017-2021

Source	IMAP file	Country	Sub-region	Year
IMAP-IS	146	Slovenia	ADR	2019
IMAP-IS	440	Slovenia	ADR	2020
IMAP-IS	642	Slovenia	ADR	2021
IMAP-IS	490*	Malta	CEN	2016-2020
IMAP-IS	147	Lebanon	AEL	2019
IMAP-IS	649	Lebanon	AEL	2017-2021
IMAP-IS	605	Israel	AEL	2021

Reported directly to MED POL, still to be uploaded in the IMAP-IS, *data available in draft status

505. Given lack of data reported by the CPs prevents implementation of the recommendations of COP 19, the assessment of IMAP CI 21 within the 2023 MED QSR was performed using the approach applied for the 2017 MED QSR. Namely, it combines the assessment results as presented in the assessment report[66] from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020[67] and the assessment of monitoring data reported for IMAP CI 21 from Bosnia and Herzegovina, Israel, Lebanon, Montenegro and Morocco (Table 3).

506. Recent data Croatia (2021-2022) and Slovenia (2021) were reported into IMAP-IS. However, for consistency, the status of Croatia and Slovenia were not re-assessed by applying the approach used for the data set reported by Montenegro, Morocco and Lebanon (see para 14 and 15) and the assessment was based on the EEA 2020 assessment of the state of bathing water quality. The data were analyzed only to check for possible problem areas.

Table 4.7.2. Details of data on CI 21 available from IMAP_IS used in the assessment update compared to initial results (UNEP/MED WG. 533/9).

Source	IMAP file	Country	Sub-region	Year	Number stations	Number of data points per station
IMAP-IS	403-404	Morocco	WMS	2018-2019	129	10*
IMAP-IS	616	Morocco	WMS	2020-2021	147	15
IMAP-IS	262	Bosnia and Herzegovina	ADR	2017-2020	3	9,10,13
IMAP-IS	#	Montenegro	ADR	2017-2020	23	30-39
IMAP-IS	605	Israel	AEL	2021	105	20-184
IMAP-IS	649	Lebanon	AEL	2017-2021	38^	12-47

Reported directly to MED POL, still to be uploaded in the IMAP-IS, *9 stations with less than 10 data points. ^ Not all stations available for all years.

[66] https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/state-of-bathing-water/state-of-bathing-waters-in-2020
[67] The updated IMAP Guidance fact sheet for CI 21 provided in 2019 mentions the EEA as an available data source for some Mediterranean countries European and non-European.

Results of the IMAP Environmental Assessment of CI 21 in the Mediterranean region

507. The results of the assessment of the state of bathing water quality for Mediterranean countries, EU Member States and Albania are presented in Figure 5.6.1. Most (>90%) of the bathing waters in all countries were in the excellent and good GES classifications. A small percentage of bathing waters were classified as poor D category: 0.1% in Spain, 1% in France, 1.7% in Italy and 3.5% in Albania.

508. The analysis of the data reported into IMAP-IS by Croatia (2021-2022) and Slovenia (2021) indicated that the classification status of bathing water quality for both countries are the same as the status provided in the EEA 2020 assessment shown below in Figure 5.6.1.

509. The results of the assessment of the status of bathing water quality performed with data available from IMAP-IS for Lebanon, Montenegro and Morocco are presented below in Figure 5.6.2, and for Bosnia and Herzegovina and Israel in Figure 5.6.3.

510. **Lebanon**. Data were available for 38 stations for the years 2017-2021, although not all stations had data available for all years (Table 4.7.2). Out of the 38 available stations, 6 stations were classified as in excellent category, 13 stations as in good category, 4 as in sufficient category, 8 in bad category and 7 could not be classified due to insufficient data. The percentage of the stations in GES (excellent, good and sufficient category) was 61%. However, neglecting the stations that could not be classified68, the percentage of the stations in-GES was 74%. Four stations were classified in bad category based on data reported for almost all sampling days during all years stations : Dbayeh Public Beach (DBY-2), Antelias – River Mouth (ANT-2), and Beirut (BEY-4, light house and BEY-6 Ramlet-El-Bayda Public Beach).

511. **Montenegro**: Data were available for 23 stations for the years 2017-2020 (Table 3). As explained, bathing waters quality in Montenegro was classified using the same methodology as the EEA, at least16 data points over 4 seasons, however using just Intestinal enterococci values and by applying percentile evaluation of the log10 normal probability density function. Fours stations had data available for only 3 bathing seasons, but they were classified in the same way, based on the exceptions outlined in Directive 2006/7/EC and in Decision IG.20/9. Out of the 23 available stations, 21 were classified in excellent category and 2 in good category.

512. **Morocco:** Data were available for 129-147 stations for the years 2018-2021 (Table 4.7.2). Not all stations were sampled at each year. Out of the 147 available stations, 45 stations were classified in excellent category, 49 stations in good category, 17 in sufficient category, 20 in bad category and 16 could not be classified due to insufficient data. The percentage of the stations in GES (excellent, good and sufficient category) was 76%. However, neglecting the stations that could not be classified[69], the percentage of the stations in-GES was 85%.

513. **Bosnia and Herzegovina:** Data were available for 3 stations for the years 2017-2019 (Table 4.7.2). All 3 available stations were classified in excellent category.

514. **Israel:** Data were available for 105 stations for 2021 (Table 4.7.2). All the stations were classified in excellent category.

[68] Stations could not be classified because they had less than 12 sample results spread over 3-4 bathing seasons . They could be either in-GES or non-GES.
[69] Stations could not be classified because they had less than 12 sample results spread over 3-4 bathing seasons . They could be either in-GES or non-GES.

4.8. Assessment of IMAP Candidate Common Indicator 26: Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animal

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	Data for the following countries available either reported to the International Noise Register (INR-MED) of through the Noise Hotspots project led by ACCOBAMS: Algeria, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Lybia, Monaco, Malta, Montenegro, Morocco, Spain, Tunisia, Türkiye,
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO11. Energy including underwater noise
IMAP Common Indicator	cCI26. Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animal
GES Definition (UNEP/MED WG473/7) (2019)	Noise from human activities causes no significant impact on marine and coastal ecosystems
GES Targets (UNEP/MED WG473/7) (2019)	Number of days with impulsive sounds sources, their distribution within the year and spatially within the assessment area, are below thresholds
GES Operational Objective (UNEP/MED WG473/7) (2019)	Energy inputs into the marine, environment, especially noise from, human activities, are minimized

<u>*Available data*</u>

515. Data are initially obtained from the Impulsive Noise Registry (INR-MED) managed by ACCOBAMS. As explained above in Section 2, the registry is a tool defined in the Proposal of IMAP Guidance Factsheet for cCI26 (UNEP/MAP - MED POL, 2019). The INR-MED collates data reported by the countries in a standard format that is aligned with the requirements indicated in the Proposal of the IMAP Guidance Factsheet for cCI 26.

516. Data have been provided through the INR-MED by a few countries so far i.e. by France, Greece, Malta, Greece, Lebanon and Montenegro. They are related to two kinds of sound sources: seismic surveys and explosions. These data cover, with many gaps, the period since 2016 onwards. They concern 247 explosions, 13 seismic surveys and 9 occurrences of sonar or acoustic deterrent use. These are official data which are reported in the correct format and most of them (92%) satisfy the minimum IMAP quality requirements.

517. To complete this process, data from the ACCOBAMS Noise Hotspot assessments i.e. from the 2nd edition which was issued in 2022 and covers the period from 2016 to 2021, are also used. These data were collected directly by a group of experts appointed by the ACCOBAMS Secretariat for the period 2016-2021 and follow theoretically the same standards used for the impulsive noise registry. However, only 170 out of 388 impulsive noise events (43%) collected under the Noise Hotspot initiative were considered good enough to be used for the present initial assessment. These noise events are mainly seismic surveys (N = 53) and port extension works for which pile driving and/or explosions were used (N = 117). They

are distributed in the four Mediterranean Sub-regions and concern almost all countries bordering the Mediterranean Sea, thus completing the data available from the INR-MED.

518. Globally, 439 impulsive noise events were used for analyses. The annual distribution of noise events (i.e. buffered point sources for port works and polygons for seismic surveys and sonar and acoustic deterrents) is mapped in Figures 4.8.1. to 4.8.6. hereafter using a 20 km x 20 km spatial grid.

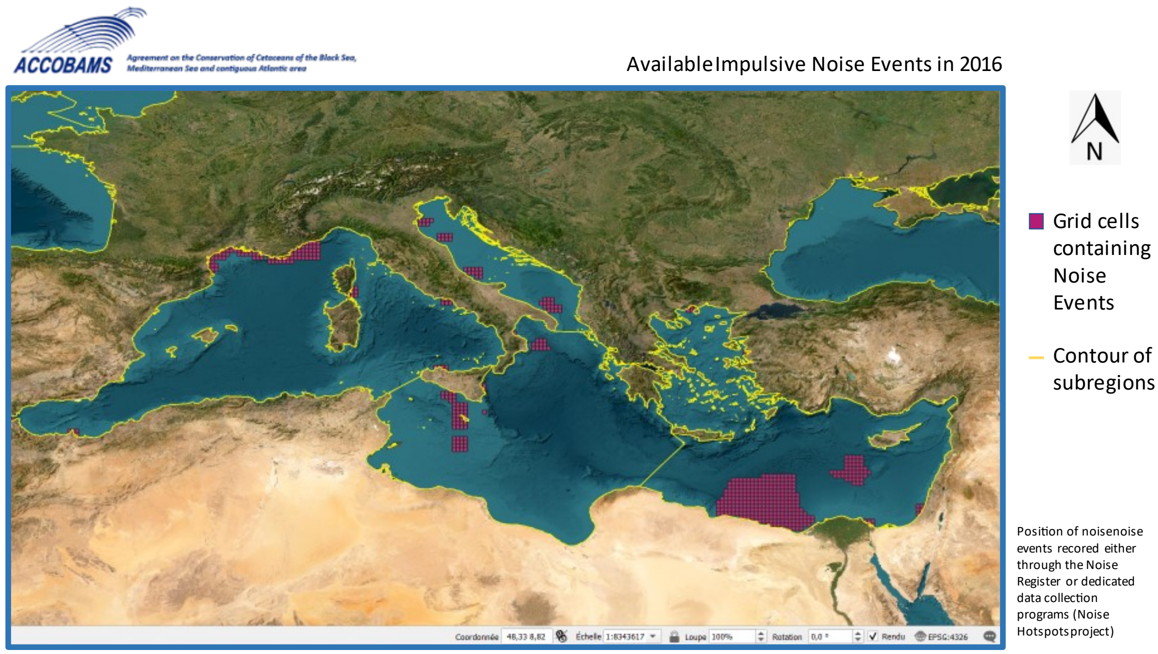

Figure 4.8.1. Impulsive noise events data for 2016. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

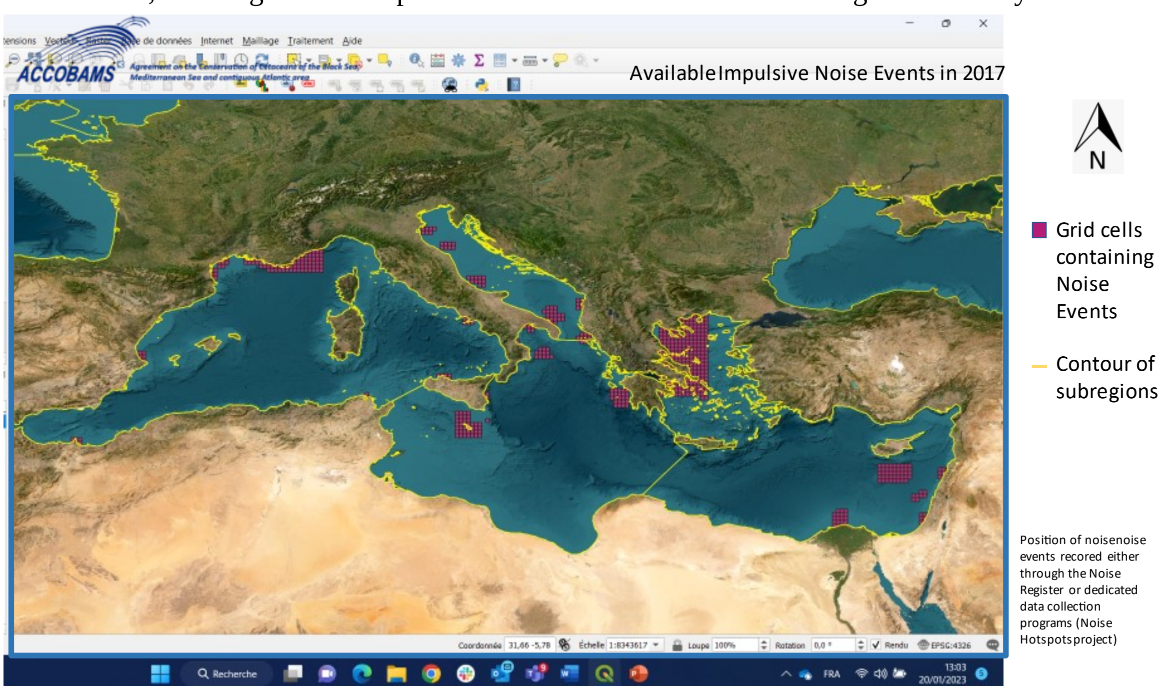

Figure 4.8.2. Impulsive noise events data for 2017. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

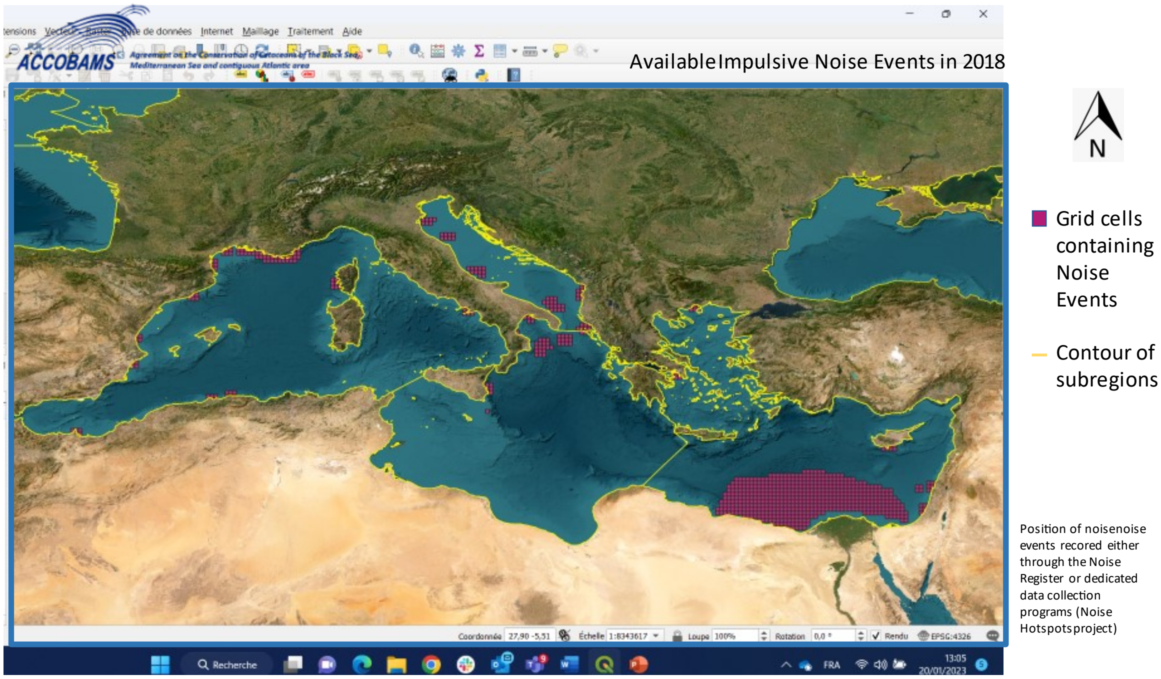

Figure 4.8.3. Impulsive noise events data for 2018. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Figure 4.8.4. Impulsive noise events data for 2019. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

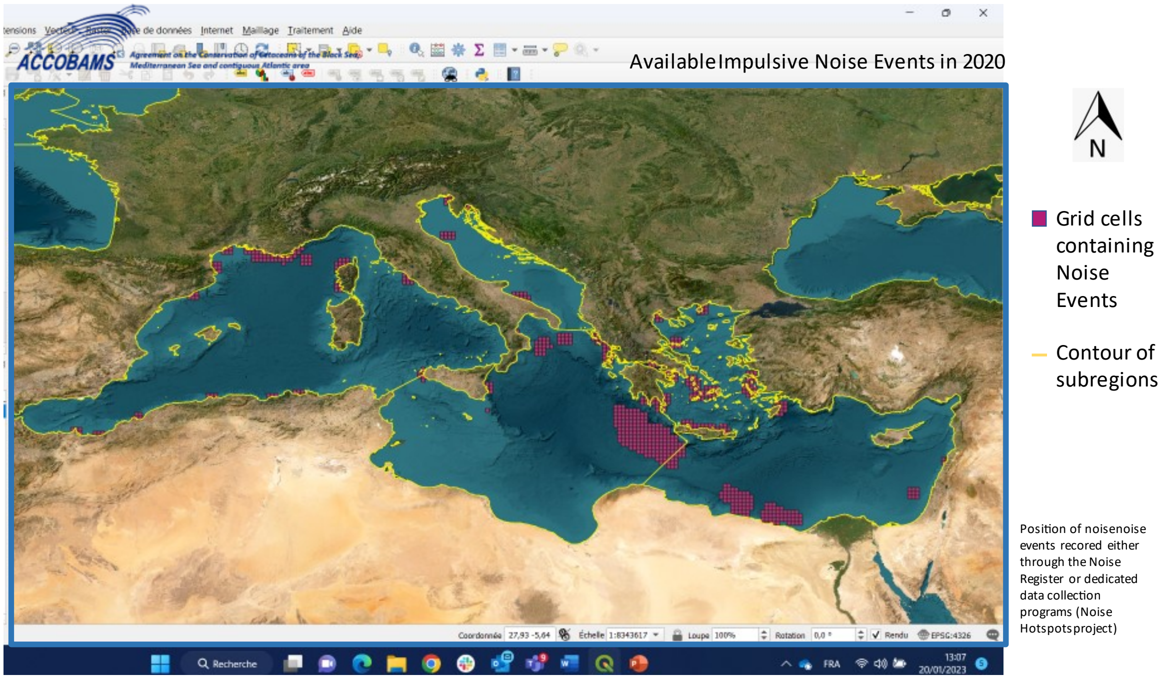

Figure 4.8.5. Impulsive noise events data for 2020. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Figure 4.8.6. Impulsive noise events data for 2021. Each purple cell indicates the position of impulsive noise events, meaning that the impulsive noise emissions occurred during at least 1 day in that cell.

Setting the GES/non GES boundary value/threshold for the initial environmental assessment of cCI 26

519. As explained in Section 2, for the purposes of the 2023 MED QSR a Tolerable Status of the environment is considered when 10% or less of the habitat of noise-sensitive species is impacted by impulsive noise events over a year. For the present initial assessment, this threshold (10%) is used for the four IMAP Sub-regions in the Mediterranean Sea.

520. The 10% threshold is based on the methodology developed under the scope of the MSFD-D11 to which the ACCOBAMS and the UNEP/MAP - SPA/RAC gave a crucial contribution. Based on the scientific works which indicate that when the exposure to underwater sound is permanent, the displacement of animals due to acoustic disturbance can be considered as a habitat loss (e.g., Brandt et al., 2018; Graham et al., 2019; Thompson et al., 2013), it was considered that the present initial assessment methodology translates the loss of habitat due to acoustic disturbance into a decline of population following a linear model as suggested by (Tougaard et al., 2013).

521. In other words, if the 10% of the habitat of a representative noise-sensitive species is impacted by noise, it is expected that the population will decline by 10% in the long-term. Considering the risk of extinction, 10% is considered sufficiently conservative and precautionary to be selected as the boundary between tolerable and non-tolerable status of a Sub-region i.e., as the boundary value/threshold limit between the GES and non GES.

Results of the initial IMAP Environmental Assessment of cCI 26 in the Mediterranean region

522. Data collected through the Noise Register lacked geographical representativeness (data from only 5 countries: France, Malta, Greece, Lebanon and Montenegro) and had to be integrated with data collected from dedicated activities led by ACCOBAMS (Noise Hotspot data). Under the 'Noise Hotspot' project, data related to impulsive noise events were found for the period 2016-2021 in waters in front of most Mediterranean countries. However, these data presented uncertainties or gaps in the source level and duration in days of activities that made it impossible either to apply propagation modelling to noise events and compute refined noise footprints, or to compute the number of days with impulsive noise events in the Mediterranean region, as whole, or in its Sub-regions.

523. By pooling together data from the International Noise Register (data from reporting countries) and the Noise Hotspot project (data from scientific study), a database was obtained covering the four Mediterranean Sub-regions, and with sufficient quantity and quality of data to carry out an initial assessment for cCI26.

524. The value of LOBE was not assigned due to heterogeneity of data and hence using refined acoustic propagation modelling to calculate the noise footprint of the impulsive noise events was not possible. Instead, a 20-km fixed buffer was used from point noise source (e.g. pile driving in ports) in order to account for propagation of noise. The 20-km buffer is selected based on scientific literature (Merchant et al., 2017; Tougaard et al., 2009). For noise sources described with polygons (such as seismic surveys), it was considered that using polygons for describing a moving point source (the seismic vessel using the airguns) is already an overestimation of the area where the noise is produced, and hence no additional buffer was applied. Moreover, without consideration of the duration in days for many noise events (corresponding to 38% of data), it was impossible to calculate the daily cumulated area affected by noise (daily exposure), which is at the basis of the calculation of the average extent of habitat affected by noise over a year i.e., the Exposure Index.

525. Considering these issues, the annual surface of the four Mediterranean Sub-regions with impulsive noise events was computed by summing up the areas of all the noise events described by polygons and buffered point sources, per sub-regions. Subsequently, the proportion of potentially usable habitat area (PUHA i.e. Potentially Usable Habitat Area, following habitat models developed by Azzellino et al., 2011) which is found on areas concerned by noise events is computed for selected

cetacean species, namely the fin whale for the Western Mediterranean sub-region, while the bottlenose dolphin, the sperm whale and the Cuvier's beaked whale for the four Sub-regions. The result of this calculation is the amount of habitat impacted by noise i.e., the adapted Exposure Index, which provides an insight of the risk of decline in population of selected species of cetaceans.

526. Percentages of areas covered by noise events per Sub-regions and for the whole Mediterranean since 2016 have been calculated and provided in the graphs below.

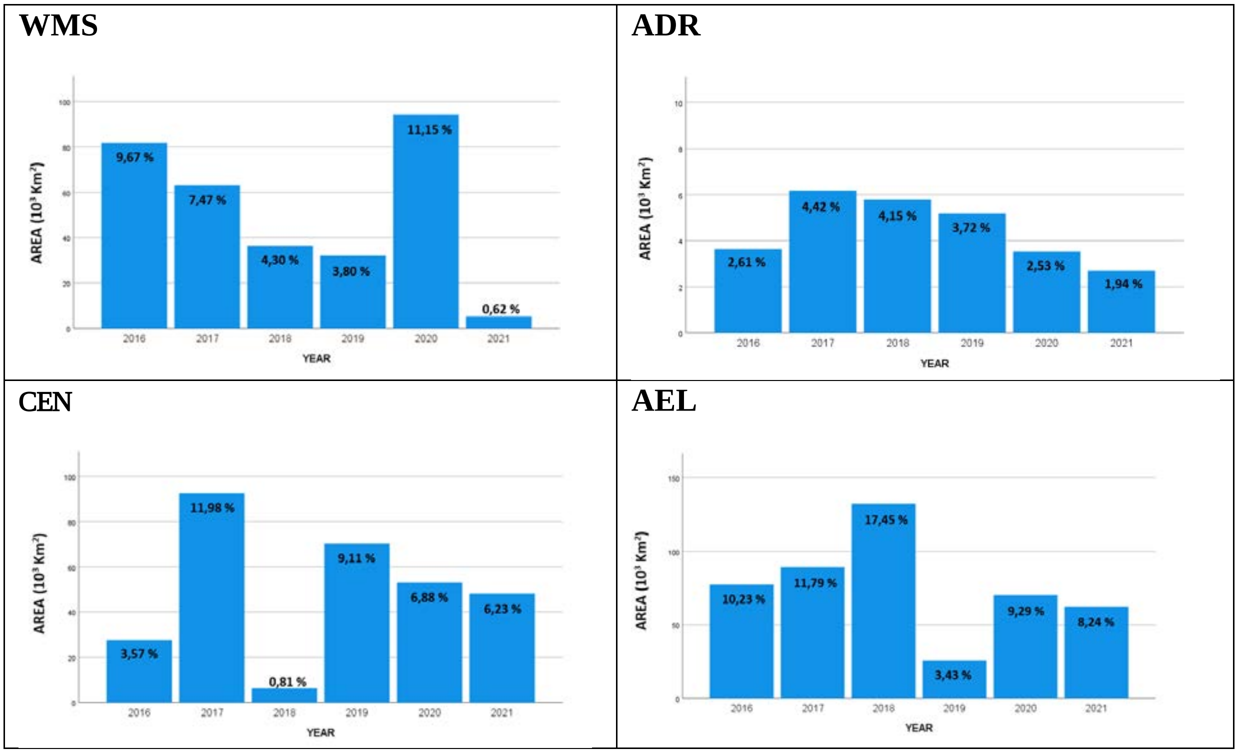

Figure 4.8.7. % of sub-regions covered by noise events per year since 2016: **WMS**= Western Mediterranean; **ADR** = Adriatic Sea; **CEN** = Ionian and Central Mediterranean Seas; **AEL**= Aegean and Levantine Seas.

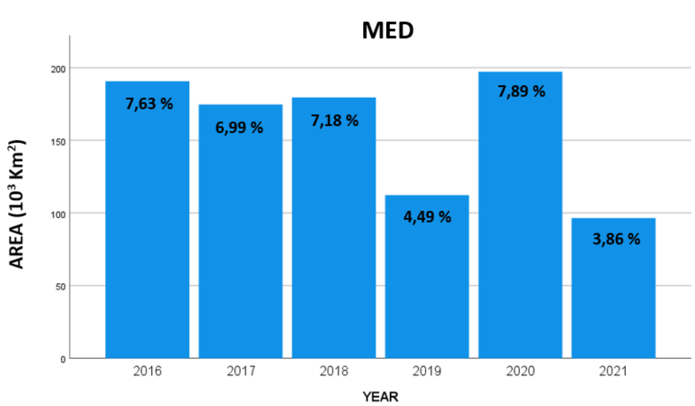

Figure 4.8.8. % of the Mediterranean region covered by noise events per year since 2016.

527. To overlap noise event areas to the species habitat an analysis grid is used of about 20 km mesh size (i.e. 10’ x 10’ grid cells) and the concept of PUHA, here applied as habitat proxy. The PUHA is computed from presence/absence habitat models using physiographic predictors as covariates (depth and slope statistics) which estimate the presence probability of the representative cetacean species in the area of interest. Based on this presence probability for a species, called Habitat Suitability (HS), the usable habitat (in km²), is calculated in every cell unit of the analysis grid by multiplying the HS for the area of the cell unit. The PUHA is then calculated (in km²) for the subregions by summing up the usable habitats single grid cells in the different subregions.

528. Table 4.8.1 shows the percent of habitat (PUHA) of a species affected by impulsive noise for every year from 2016 to 2021. Four species are considered: bottlenose dolphin, sperm whale and Cuviers’ beaked whale, and only for the WMS subarea fin whale.

Table 4.8.1: Summary of the percent impacted PUHA for the four selected cetacean species (e.g. bottlenose dolphin, sperm whale and Cuviers’ beaked whale, and fin whale). For the year 2018, the percent of impacted PUHA for sperm whale and Cuvier’s beaked whale is highlighted in red and percent of impacted PUHA of bottlenose dolphin, being close but lower than the 10% GES/non GES boundary limit is highlighted in light blue.

IMAP SUB-REGIONS	**AFFECTED AREA (% POTENTIALLY USABLE HABITAT AREA IMPACTED BY IMPULSIVE NOISE) PER YEAR IN THE PERIOD 2016-2021**						
	Bottlenose dolphin						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
ADR	4,81	6,59	6,48	6,27	3,03	2,88	5,54
AEL	4,76	5,21	**8,62**	1,17	4,27	1,39	4,52
CEN	1,28	1,45	0,66	4,02	2,9	2,48	1,97
WMS	1,52	1,34	1,26	1,48	1,63	0,45	1,41
	Fin whale						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
WMS	0,99	1,02	0,67	0,74	1	0,23	0,87
	Sperm whale						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
ADR	1,48	2	1,97	1,77	0,69	0,64	1,63
AEL	**8,2**	2,59	**11,51**	0,88	3,36	2,12	3,11
CEN	0,63	0,83	0,55	7,39	5,62	5,47	3,15
WMS	0,84	0,94	0,47	0,49	0,78	0,16	0,63
	Cuvier's beaked whale						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Median**
ADR	1,41	2,44	2,37	1,78	0,25	0,28	1,59
AEL	6,18	4,77	**10,15**	0,97	4,75	1,95	4,76
CEN	1,27	1,64	0,83	6,1	4,88	4,41	3,02
WMS	1,22	1,17	0,99	1,19	1,49	0,38	1,18

529. It can be observed that in the 2016-2021 average scenario (median level), the 10% GES/non GES boundary limit was not exceeded, being very far for all the considered species. However, for some year (e.g. in 2018), the 10% GES/non GES boundary limit might have been exceeded in the Aegean-Levantine Sub-region (AEL) concerning the habitat of sperm whale and Cuvier's beaked whale. In such a case, the environmental status may be considered non tolerable for the year 2018 i.e. the non GES can be indicated.
530. For the Western Mediterranean (WMS), the Adriatic Sea (ADR) and the Central Mediterranean Sea (CEN), the environmental status appears as tolerable for all years.

4.9. Assessment of IMAP Candidate Common Indicator 27: Levels of continuous low frequency sounds with the use of models as appropriate

Geographical scale of the assessment	The Sub-regions within the Mediterranean region
Contributing countries	**All ACCOBAMS Contracting Parties** which participate in setting and maintenance of the NETCCOBAMS platform: Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Georgia, Greece, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Portugal, Romania, Slovenia, Spain, Syria, Tunisia, Türkiye, Ukraine
Mid-Term Strategy (MTS) Core Theme	Enabling Programme 6: Towards Monitoring, Assessment, Knowledge and Vision of the Mediterranean Sea and Coast for Informed Decision-Making
Ecological Objective	EO11. Energy including underwater noise
IMAP Common Indicator	cCI27. Levels of continuous low frequency sound with the use of models as appropriate
GES Definition (UNEP/MED WG473/7) (2019)	Noise from human activities causes no significant impact on marine and coastal ecosystems
GES Targets (UNEP/MED WG473/7) (2019)	Noise levels at monitoring stations are below thresholds; The extent (% or km²) of the assessment area which is above levels causing disturbance to sensitive marine animal is below limits, or such limits are exceeded for a limited amount of time
GES Operational Objective (UNEP/MED WG473/7) (2019)	Energy inputs into the marine, environment, especially noise from, human activities, are minimized

Available data

531. For cCI27 data are obtained from the NETCCOBAMS Platform, a digital tool managed by ACCOBAMS that centralizes all relevant data regarding cetaceans and related anthropogenic threats. The platform contains maps of shipping noise distribution over the entire Mediterranean basin in the two out of the five frequency bands of interest (1/3 octave bands centered at 63 Hz and 125 Hz). Shipping noise maps were obtained from modelling techniques which corresponds to requirements indicated in the Proposal of the IMAP Guidance Factsheets for cCI27 (UNEP/MAP MED POL, 2023).

532. Availability of these NETCCOBAMS maps of shipping noise in the two frequencies is also aligned with the ACCOBAMS Monitoring Strategy (2015) on underwater noise monitoring and the EU recommendations contained in the Monitoring Guidance prepared by TG-Noise for the MSFD-D11 (Dekeling et al, 2014).

533. These maps are produced by modelling tools provided by the SINAY company which is specialized in underwater acoustic. It developed the necessary technology to set up the NETCCOBAMS platforms (Maglio et al., 2015, 2017). Acoustic propagation is based on the RAM model (Collins, 1993) and inputs for the models available in AIS data for ships parameters and ship traffic (source: Spire Group, a US based company), as well as in EMODnet and COPERNICUS data platforms (EmodNet and Copernicus) providing environmental variables influencing the propagation of radiated noise.

534. An overview of the available data on ship traffic patterns is shown in Figure 4.9.1. This map, available in NETCCOBAMS, was produced based on the ship traffic density provided based on AIS data in 2017 (source: Spire Group). Ship traffic patterns appears quite stable year-to-year and the ship density that can be obtained from AIS data generally shows the same patterns overall, regardless of the period chosen for analysis. Major ship lanes are found between the Gibraltar Strait and the Suez Cannel as well as in other lanes connecting the major ports in the Mediterranean Sea area. High traffic areas are located in the Strait of Sicily, the central and northern Adriatic Sea, the Aegean Sea and several coastal areas, especially located in the northern side of the Mediterranean. However, depending on the kind of vessels navigating in the different areas, areas characterized by high noise levels may not follow the same pattern as the ship traffic.

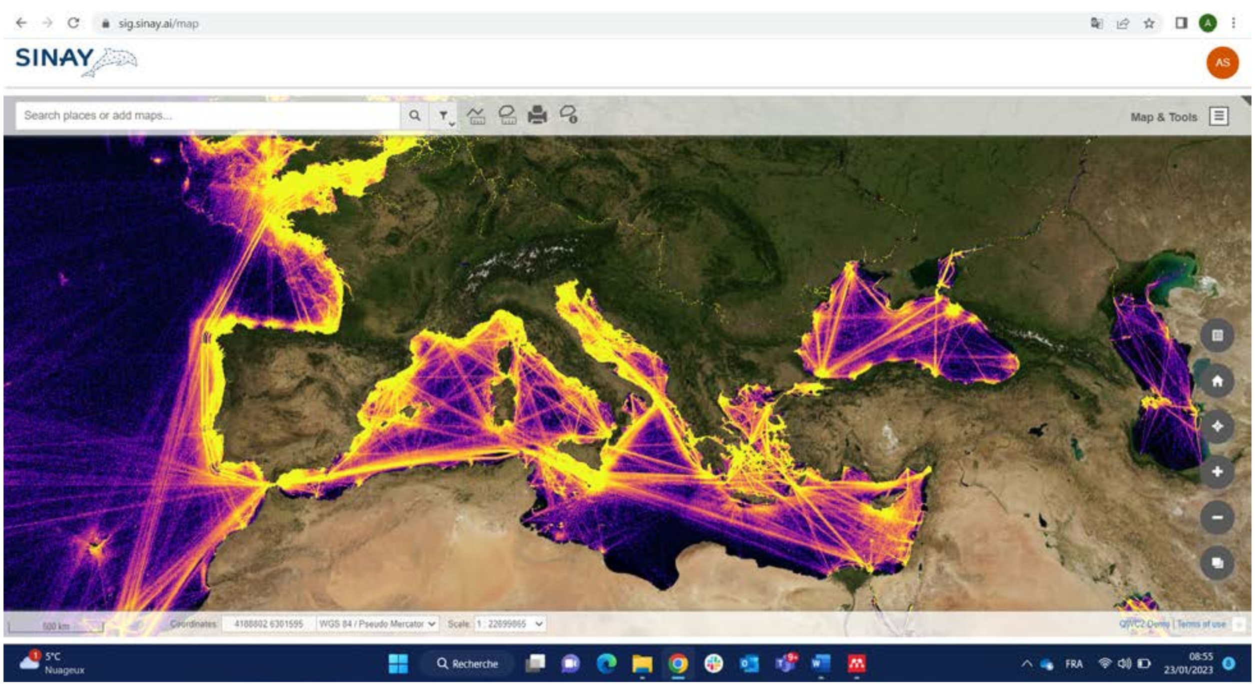

Figure 4.9.1: Ship traffic density as total count of AIS messages per grid cell (0.01° in latitude and longitude) for 1 year (2017 in this case). The patterns shown in this map (ship lanes, traffic hotspots, low- and high-density areas) are quite stable year-to-year and can be considered representative of usual ship traffic conditions in the Mediterranean Sea. Source of raw AIS data used in NETCCOBAMS: Spire Group.

535. The above noise map, satisfying the minimum requirements for the assessment related to cCI27 refers to median ambient noise levels for the month of July 2020. Given the relative stability of the ship traffic levels and characteristics within a time window of a few years, and that the ship traffic is at the highest levels during summer months, the assessment produced for month of July 2020 can be generalized to other years, and can be seen as the worst case scenario within a year[70].

536. Further relevant sources of data are indirectly explored. These are the ambient noise levels from *in-situ* measurements in the Balearic Sea collected within the QUIETMED project (quietmed-project.eu) which were used to calibrate the models implemented in NETCCOBAMS. Despite additional *in-situ* measurements are required to continue improving the model which would estimate situation in the four Mediterranean subregions. The first validation was achieved from field data which do not directly contribute to the assessment, and therefore they are not shown in the 2023 MED QSR. Additional information on the data and the calibration process of the acoustic models is found in QUIETMED Deliverable 3.3 (Taroudakis et al., 2018).

Setting the GES/non GES boundary value/threshold for the initial environmental assessment of cCI 26

537. The overall assessment methodology developed by TG-Noise (2022) could be fully implemented for IMAP cCI27 for the month of July 2020, which is taken as basis for assessing the status i.e. tolerable/non-tolerable that might be considered correspondent to GES/non GES status of marine waters at the sub-regional level.

538. The average noise level for the month of July 2020 is defined as the median ambient noise level. The median is calculated from the statistical distribution of noise values obtained from the acoustic modelling (N = 93 noise maps corresponding to shipping noise levels at 93 instants, 1 every 8 hours for the period of 31 days).

539. The Level of Onset of Biological Effect (LOBE) was set at as a sound pressure level of 125 dB re 1 µPa in the 1/3 octave band centered at 63Hz and each grid cell. The value of 125 dB re 1 µPa was defined based on the models developed by Gomez et al 2016.

540. The frequency band centered at 63 Hz is selected from the list of frequency bands indicated in the Proposal of the IMAP Guidance Factsheets for cCI27 (1/3 octave bands centered at 20, 63, 125, 250, 500, 2 000 Hz) as shipping noise in this frequency bands generally dominates in the underwater ambient noise.

541. With regards to cetacean species selected for the assessment, the fin whale is selected for the Western Mediterranean Sea Sub-region, and the bottlenose dolphin for the other three Mediterranean Sub-regions. The proportion of the potentially usable habitat areas (PUHA, following Azzellino et al, 2011) of these species that is found on areas with median shipping noise higher than LOBE (125 dB re 1 µPa) is computed. The result of this calculation is the amount of habitat impacted by noise i.e., the Exposure Index which provides an estimate of the risk of decline of the selected species population.

542. For the purposes of the 2023 MED QSR, a Tolerable Status of the environment is defined when 20% or less of the habitat of noise-sensitive species is impacted by continuous noise on a monthly basis. This threshold of 20% applies to all months of the year. If one month is above 20%, the environmental status is considered non tolerable. It is used for all four Mediterranean sub-regions.

543. The 20% threshold is based on the methodology developed under the scope of the MSFD-D11 to which the ACCOBAMS and the UNEP/MAP - SPA/RAC gave a crucial contribution. Based on the scientific works demonstrating that the exposure to underwater continuous noise induce adverse effects (e.g. behavioral disturbance, stress, reduced communication space, and temporary or permanent habitat

[70] Furthermore, a new noise map for the month of July 2021 should be available in NETCCOBAMS in the coming months. The noise map for July 2021 will allow to compare the status in July 2020 with the status in July 2020, to test assumption described in paragraph above.

loss) which in turn could reduce the fitness, and hence the reproductive success of individuals (e.g. CBD, 2012), it was considered that the present initial assessment methodology translates the degradation of portions of habitat due to acoustic disturbance into a decline of population following a linear model as suggested by Tougaard et al (2013). In other words, if the 20% of the habitat of a representative noise-sensitive species is impacted by high levels of continuous noise, it is expected that the population will decline by 20% in the long-term.

544. An acceptable status i.e., the GES relative to continuous noise is achieved if in every month over a year, the area exposed to noise level higher than LOBE is equal to or below 20% of the habitat of a selected species. This is found as an optimal boundary value after considering that shipping is nowadays a permanent characteristic of the habitats and it has probably shaped the populations' carrying capacity since decades. This consideration, along with the fact that the scientific literature about the noise effects does not suggest any strong relationship of the shipping-related noise with any dramatic reduction of the population sizes, determines the setting for continuous noise of a less restrictive threshold than for the impulsive noise. This threshold of 20% of habitat of a species exposed to continuous noise in the long term is hence used as a baseline to assess whether at least this initial minimum target is achievable. It should ensure the viability of a population size at 80% of the carrying capacity. This number is therefore subject to further possible adjustments.

Results of the initial IMAP Environmental Assessment of cCI 27 in the Mediterranean region.

545. Figure 4.9.2 shows the distribution of median noise levels in the 1/3 octave band centered at 63 Hz for the month of July 2020. Considering that the median divides a distribution of values sorted from lowest to highest in the two parts, each containing 50% of the values, the median noise informs that during 50% of the time the levels are higher than those shown at each point of the area as depicted in Figure 4.9.2, and in the other 50% of the values are lower. The median value is a good indicator of a 'typical' ambient noise value that can be measured in a zone because it is not influenced by small portions of very high or very low values, as it would be the case by applying the arithmetic mean.

546. Beyond indication of the typical values of ambient noise of an area, the median noise can also indicate that if the values are high enough to induce the negative effects in individuals of sensitive marine species, they are even higher for the 50% of the time. In such a case, the exposure to the levels inducing negative effects occurs very frequently i.e. during 50% of the time and potentially for a long period of time (e.g. hours to days of continuous habitats` exposure), eventually increasing the risk for populations.

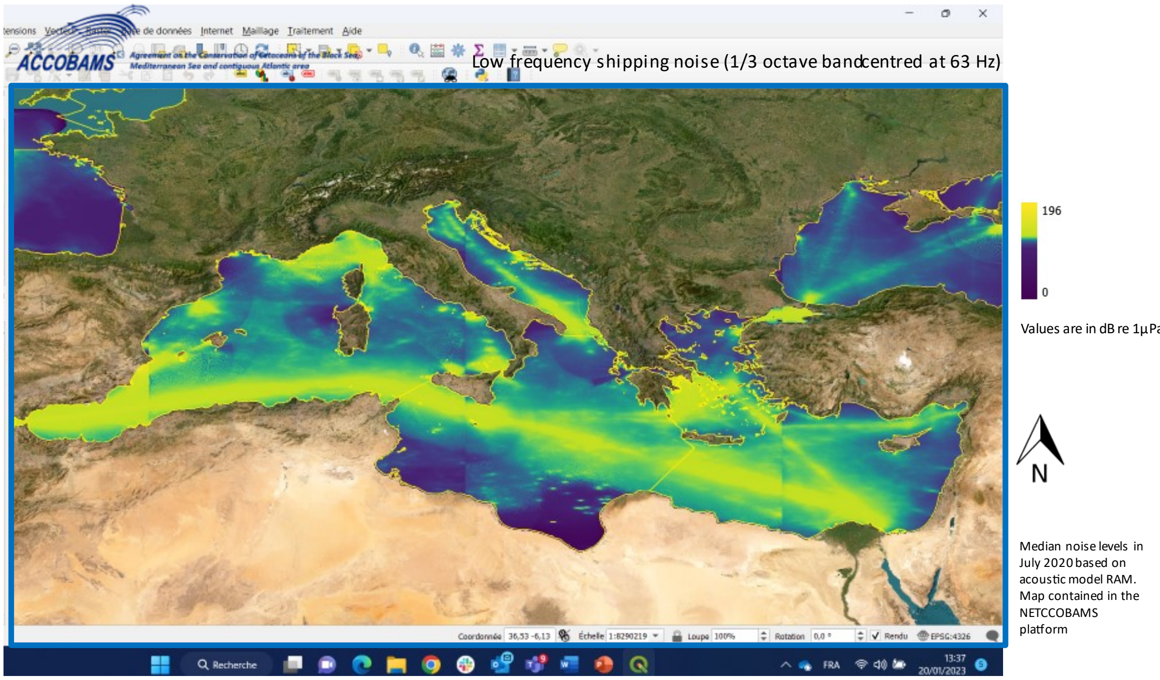

Figure 4.9.2: Median shipping noise levels in month of July 2020 based on the acoustic model RAM (Collins, 1996), contained in the NETCCOBAMS platform.

547. By analyzing Figure 4.9.2. on the median shipping noise, the main ship lanes can be distinguished (e.g., Gibraltar to Suez) from the areas of diffused noise around port areas, where the median noise levels are estimated at around 140 dB re 1µPa or higher. Also, the areas with lower or very low ship traffic levels (e.g. offshore waters between Sardinia, the Balearic Islands and southern French coast) present median noise levels in the range 100-110 dB re 1µPa. A few areas present the median values below 100 dB re 1µPa, and especially those in Libyan waters due to very low ship traffic and the distance from heavy traffic areas. Also, some high vessel traffic areas do not correspond to high median noise levels (e.g. waters around Cyprus, the Central and the Northern Adriatic Sea).

548. The percentage of habitat of the fin whale and the bottlenose dolphins which is found where the median shipping noise is higher than 125 dB re 1µPa is calculated for the Western Mediterranean Sea Sub-region, and for all four Mediterranean Sub-regions, respectively. The results of the assessment indicating tolerable/ non-tolerable i.e. GES/non GES are summarized here-below in Table 4.9.1

Table 4.9.1: Summary of the percent impacted habitat (PUHA) for the two selected cetacean species (i. bottlenose dolphin for all subregions, and ii. fin whale for Western Mediterranean Sea,) for the month of July 2020. The 20% threshold is exceeded in the Western Mediterranean Sea with relationship to both bottlenose dolphin and fin whale habitats, and in the Aegean and Levantine Seas with the relationship of bottlenose dolphin habitat.

BOTTLENOSE DOLPHIN

IMAP SUB-REGION	**Affected habitat**: % of potential usable habitat area (PUHA) overlapping median shipping noise levels higher than LOBE (125 dB re 1µPa)	Result of the assessment
WMS	**35.02%**	Non tolerable
ADR	15.53%	Tolerable
CEN	15.84%	Tolerable
AEL	**27.59%**	Non tolerable

FIN WHALE

IMAP SUB-REGION	**Affected habitat**: % of potential usable habitat area (PUHA) overlapping median shipping noise levels higher than LOBE (125 dB re 1µPa)	Result of the assessment
WMS	**31.53%**	Non tolerable

549. The computation of the Exposure Index results in non-tolerable i.e. in non GES for the Western Mediterranean Sea and the Aegean Levantine Sea Sub-regions i.e., % affected habitat > 20%, while the status is tolerable i.e., GES in the Adriatic Sea and Central Mediterranean Sea Sub-regions.

4.10. GES Assessment for the Ecological Objectives: the key highlights related to the feasibility of integration and aggregation among CIs 13, 14, 17, 18, 21, 26 and 27 and EOs 5, 9 and 11[71]

4.10.1. IMAP Common Indicators 13 and 14

550. To support integration and aggregation among CIs and EOs within the preparation of the 2023 MED QSR, several methodologies were tested regarding the assessment of CIs 13 and 14. Further to the results of the IMAP NEAT methodology application for the assessment of contaminants in the Adriatic Sea Sub-region, it was also applied to assess eutrophication, whereby aggregation of spatial assessment units was provided across different water typologies and assigning GES/non-GES classifications of

[71] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:
- Further to the findings on *possible* integration of an individual CI with other CIs, elaborate the integrated GES assessment findings at the level of: (i) EO, to which the CI(s) belongs; (ii) between EOs of different IMAP pollution clusters
- Summary of GES using traffic-light system, per CI
- SIDA project on GES in the Adriatic as a case study
- Example to interrelate DPSIR and GES assessments

relevance for the assessment of nutrients and chlorophyll *a*.

551. The simplified methodology based on G/M comparison was applied for the assessment of CI 14 in the Alboran Sea and Levantine Sea Sub-divisions, as an alternative environmental assessment methodology given the status of data reported, in particular lack of homogenous and quality assured data prevented the application of NEAT GES assessment.

552. Towards finalization of the 2023 MED QSR, the simplified methodology based on G/M comparison will also be applied in other Sub-regions/sub-divisions of the Mediterranean i.e. where the application of NEAT GES assessment was impossible.

553. Only the application of NEAT assessment methodology ensured integrated assessment of CIs 13 and 14, along with with integration and aggregation of the areas of assessment in line with the nesting approach of IMAP.

4.10.2. IMAP Common Indicator 17

554. Compared to the 2017 MED QSR "traffic light" methodology which considers the data per CI, matrix and station alone, the 2023 MED QSR methodologies are aimed at supporting integration and aggregation among CIs and EOs, as well as aggregation of the areas of assessment through spatial assessment units, while assigning GES/non-GES classifications, in line with the nesting approach of IMAP. To that purpose the wo methodologies were developed and applied for assessment of IMAP CI17, as explained above, i.e., the NEAT (Nested Environmental Assessment Tool) for to areas with sufficient data and the CHASE+ (Chemical Status Assessment Tool) for the areas with limited data availability.

555. Both methodologies applied for assessment of CI 17 supported integrated assessment to the extent possible. The NEAT IMAP GES assessment ensured optimal assessment of the cumulative impacts of all groups of mandatory contaminants, along with integration and aggregation of the areas of assessment in line with the nesting approach of IMAP. The CHASE+ methodology ensured assessment of groups of mandatory contaminants, however only at monitoring stations, without integration of the assessments along the spatial assessment unit.

556. Along with the integration at the level of CI 17, its interrelation with the assessment of CI 20, was ensured by using data reported for IMAP CI 17 for the assessment of IMAP CI 20.

557. Any further integration at the level of EO 9 or within the IMAP Pollution Cluster was impossible within the preparation of the 2023 MED QSR by applying rules for integration and aggregation as elaborated in section 2.4.

4.10.3. IMAP Common Indicator 18

558. The assessment approach applied for CI 18 did not allow for assessing the environmental status of the Mediterranean Sea given it was based on the literature sources due to the absence of any national data reporting. Therefore, it was possible to present overall assessment findings for the Mediterranean sub-regions without GES/non GES status classification and related integration-aggregation of the results at CI 18, EO 9 and IMAP Pollution Cluster levels.

4.10.4. IMAP Common Indicator 19[72]

4.10.5. IMAP Common Indicator 20

559. By using data reported for CI 17 and data available from the literature, in the absence of any data reported for CI 20, certain integration of these two indicators was achieved. Data from IMAP-IS concerning contaminants in biota (CI 17) were assessed by applying the new assessment criteria set for CI 20. In addition, since these criteria were in line with the EU regulations, the harmonization of IMAP and

[72] This section is under preparation

MSFD implementation was improved.

560. Possible integration of IMAP CI 20 with IMAP CI 23 (microplastic) may be feasible in future assessments. Human health may be impacted either by consuming seafood with microplastic content, or seafood with contaminants that were leached from the microplastic to the organism.

4.10.6. IMAP Common Indicator 21

561. Lack of data reported by the CPs the assessment of IMAP CI 21 within the 2023 MED QSR was prepared by applying the approach used for the preparation of the 2017 MED QSR. Namely, it combined the assessment results as presented in the assessment report from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020 and the assessment of monitoring data reported for IMAP CI 21 from 9 CPs, as described in section 4.5. Any integration of the assessment findings related to CI 21 was impossible at the level of EO 9 or within the IMAP Pollution Cluster in line with the integration and aggregation as elaborated in section 2.4.

4.10.7. IMAP Candidate Common Indicators 26 and 27

562. At the indicator level mentioned above for cCI26 only one parameter needs to be measured, i.e., the number of days with impulsive noise events per unit area which is 20 km x 20 km grid in line with the Proposal of the IMAP Guidance Factsheet for cCI 26, and hence integration of different measured parameters is not relevant for cCI 26.

563. For cCI27, five frequency bands are recommended for monitoring in the Proposal of the IMAP Guidance Factsheet for cCI27 , namely the 1/3 octave bands centered at 20 Hz, 63 Hz 125 Hz, 250 Hz, 500 Hz and 2 000 Hz, but no well-structured integration rules have been defined for the levels measured/estimated at the different frequency bands. Within this initial assessment, only the 1/3 octave band centered at 63 Hz was considered because this is the frequency band were shipping noise generally dominates in ambient noise and propagates the farther, and hence represents a worst case scenario.

564. With regards to the integration of assessment methods between cCI26 and cCI27, in order to deliver an integrated assessment result for EO11, such aspects have not yet been established for IMAP nor for the MSFD process. Therefore, an integrated assessment was not delivered for Ecological Objective 11, and assessment findings were provided for cCI26 and cCI27, separately.

565. Concerning relationships with other Ecological Objectives, the purpose of the assessment related to cCI26 and cCI27 is to compute the amount and spatial distribution of underwater anthropogenic noise and assess whether or not the number of habitats affected by noise is tolerable. Hence, the present initial environmental noise assessment provides an insight into the risk of extinction of population of marine mammals, which are selected as focus species given their known sensitivity to noise and the overall importance of sound for these animals. There is also an interrelation between EO11 and EO1 given the use of biodiversity data for noise assessment. Especially, the assessment methods for both cCI26 and cCI27 require computing the extension of the potential habitat of species which are representative for the different sub-regions (e.g., the fin whale for the Western Mediterranean Sea Sub-region) in order to calculate how much (in %) of the habitat is impacted by noise levels above the Level of Onset of Biological Effects (LOBE).

In the long term, as the assessment methodology will progress in addressing the risk of extinction of population of marine mammals due to noise disturbance, it can be expected that the population abundance of selected species i.e. CI 4 of EO1 will be harmonized with the assessment of EO11. For example, if the assessment results in an increase of the amount of habitat affected by noise in a reporting cycle compared to the preceding one (i.e., the risk of extinction has increased), then it can be expected that the abundance of the population of the species will decline at some

5. Key findings per CI[73]

5.1 Key assessment findings for IMAP Common Indicators 13 and 14

5.1.1 The IMAP Environmental Assessment of the Aegean and Levantine Seas (AEL) Sub-region

a) The Levantine Sea Sub-division

566. The results of the CI 14 assessment provided by application of the Simplified assessment methodology based on G/M comparison on the COPERNICUS satellite derived Chl*a* are shown by the respective colour in the maps included in Figures LEVS 5.1.1.E and LEVS 5.1.2.E.

567. The maps depict the acceptable and non-acceptable statuses i.e. likely GES/non GES assigned at the level of SAUs set in the Levantine Sea Sub-division. As explained above in Section 4, the likely GES corresponds to the RC conditions class (column oN10 in Tables 4.2.1. 4 and 4.2.1.5), as well as to the class between the RC and G/M boundary limit, set as the back transformed 85th percentile of normalized distribution (i.e. blue coloured cells in the last G_N.G.oN85 column of 4.2.1.4 and 4.2.1.5), which is depicted in blue coloured SAUs in Figure LEVS 5.1.1.E. The likely non GES corresponds to the class above G/M boundary limit (i.e. red coloured cell in the last column of 4.2.1.5) which is depicted in red coloured SAUs in Figure LEVS 5.1.1.E.

568. As elaborated in Section 4, further to likely GES assigned to the assessment zones, it can be preliminary found that only 1 out of 18 SAUs is likely in non GES. This likely non GES SAU is located in the OW in the southern part of the Eastern Levantine Sea, and the local sources of pollution are probably the main driver contributing to the weakened status of the SAU.

569. The results of the present CI 14 assessment in the Levantine Sea Sub-division represent only an indication of possible GES/non GES at the level of the SAUs, whereby SAUs are not set at the same level of spatial finesse. Namely, the reliability of the assessment was negatively affected by the lack of data reported by the CPs in IMAP IS, and therefore impossibility to use the IMAP NEAT GES assessment as applied to the Adriatic Sea Sub-region.

570. The results of additional assessment performed for every satellite derived Chl*a* point of the data grid are depicted in Figure LEVS 5.1.2.E. This assessment is only indicative of the present environmental status given the high geographical variability of the biogeochemical processes at such scale (1 x 1 km).

571. However, these additional assessment results indicated the main biogeochemical controlling processes in the Levantine Sea i.e. the main impacted area located in front of Mersin and in the Iskenderun Bay, a slight impact along the coast of Israel and in the OW in the southern part of the Eastern Levantine Sea, as well as in front of Port Said and Alexandria, the weak influence of the Nile River, confirming the changes in the area caused by construction of the Aswan dam, and finally a coastal impact in the Tobruk area in the waters of Libya.

[73] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6:
- Further to the GES assessment findings as provided above, provide key findings on compliance and non-compliance with GES targets. In so doing, provide highlights for individual CIs – diagrams or figures, and maps if feasible (these could be in boxes).
- Endeavour to provide a comparison of the present findings with 2017 Med QSR GES assessment findings
- Identify gaps per CI that need to be further addressed towards achieving GES, considering the key knowledge gaps from the 2017 Med QSR Highlight data gaps

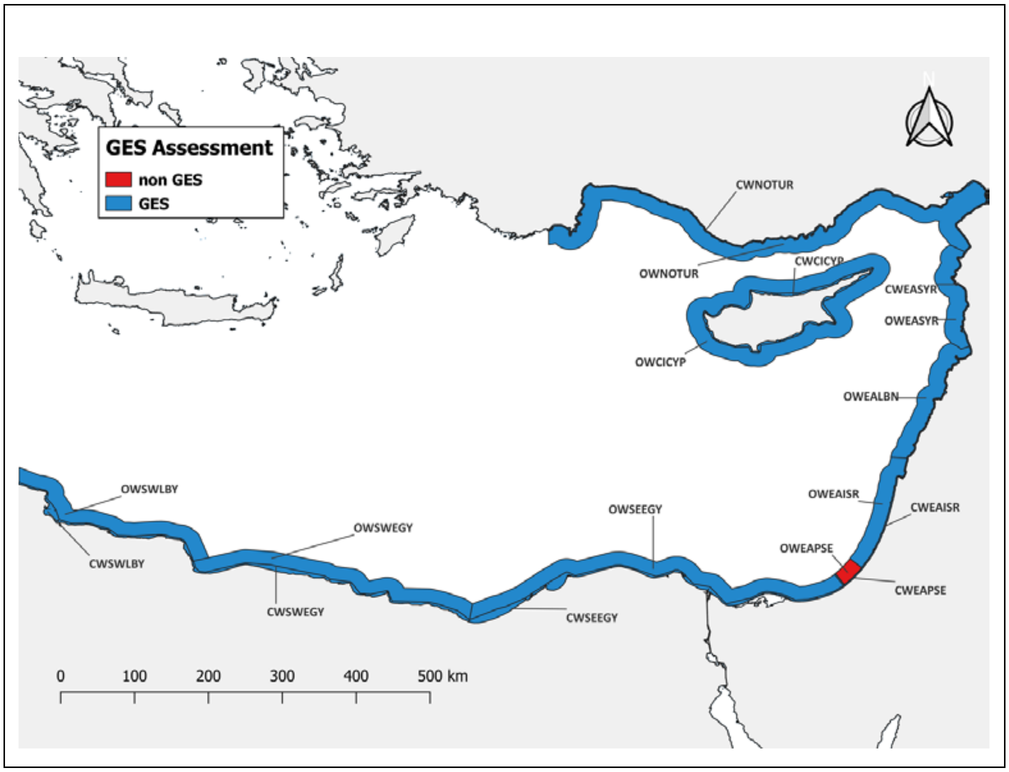

Figure LEVS 5.1.1.E: The assessment results for CI 14 in the Levantine Sea Sub-region by applying the simplified G/M method at the level of SAUs.

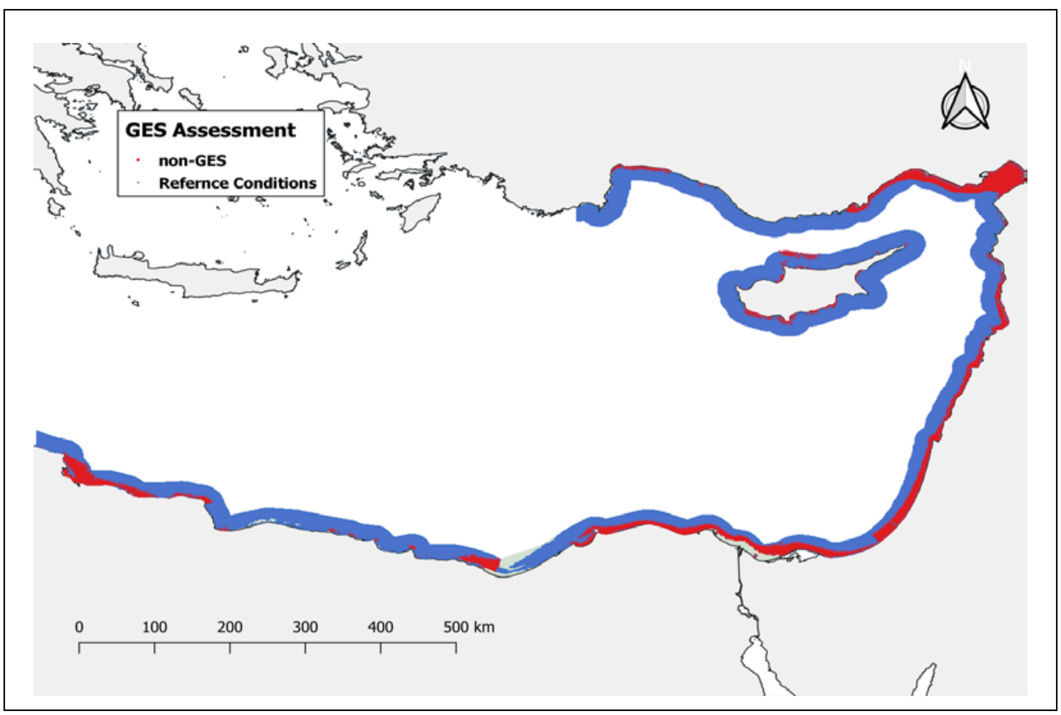

Figure LEVS 5.1.2.E : Additional assessment results for CI 14 in the Levantine Sea Sub-division by applying the simplified G/M method for satellite derived Chla points of the observation grid (1 x 1 km).

Satellite derived Chl *a* data points which indicate non-GES are plotted (coloured in red), as well as Chl *a* data points which indicate the RC conditions (coloured in blue).

5.1.2 The IMAP GES Assessment of the Adriatic Sea (ADR) Sub-region

572. The results of the assessment findings provided per TP, DIN and chlorophyll a, as presented in Table 4.2.1.3(UNEP/MAP – MED POL, 2023). Also, the final GES assessment findings for all the IMAP SAUs in the Adriatic Sea, as provided in Table 4.2.1.3 are shown by the respective colour in the maps included in the following Figures ADR 5.1.1.E- ADR 5.1.3.E. The maps depict the integrated NEAT value for each SAU i.e. aggregated NEAT value for the three parameters assessed i.e. TP, DIN and chlorophyll a, as provided in Table 4.2.2.3, Section 4.

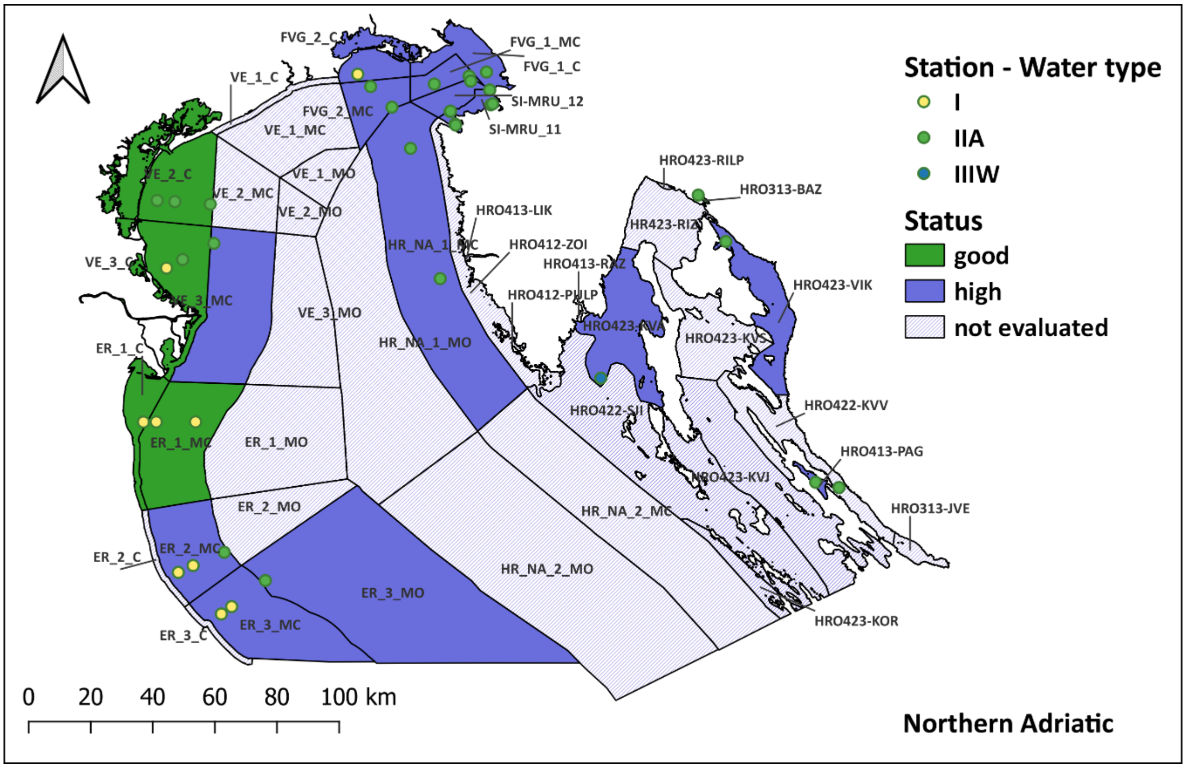

Figure ADR 5.1.1.E: The NEAT assessment results for IMAP CIs 13 and 14 in the North Adriatic Sea. All IMAP SAUs are in GES characterized by High or Good status. Blank area corresponds to not evaluated subSAUs.

573. The overall status of IMAP CI 13 and CI 14 regarding the three parameters assessed i.e. TP, DIN and chlorophyll a, on the sub-division level for NAS, is Good and in GES. Thirteen out of 20 SAUs are classified under High status and six under Good.

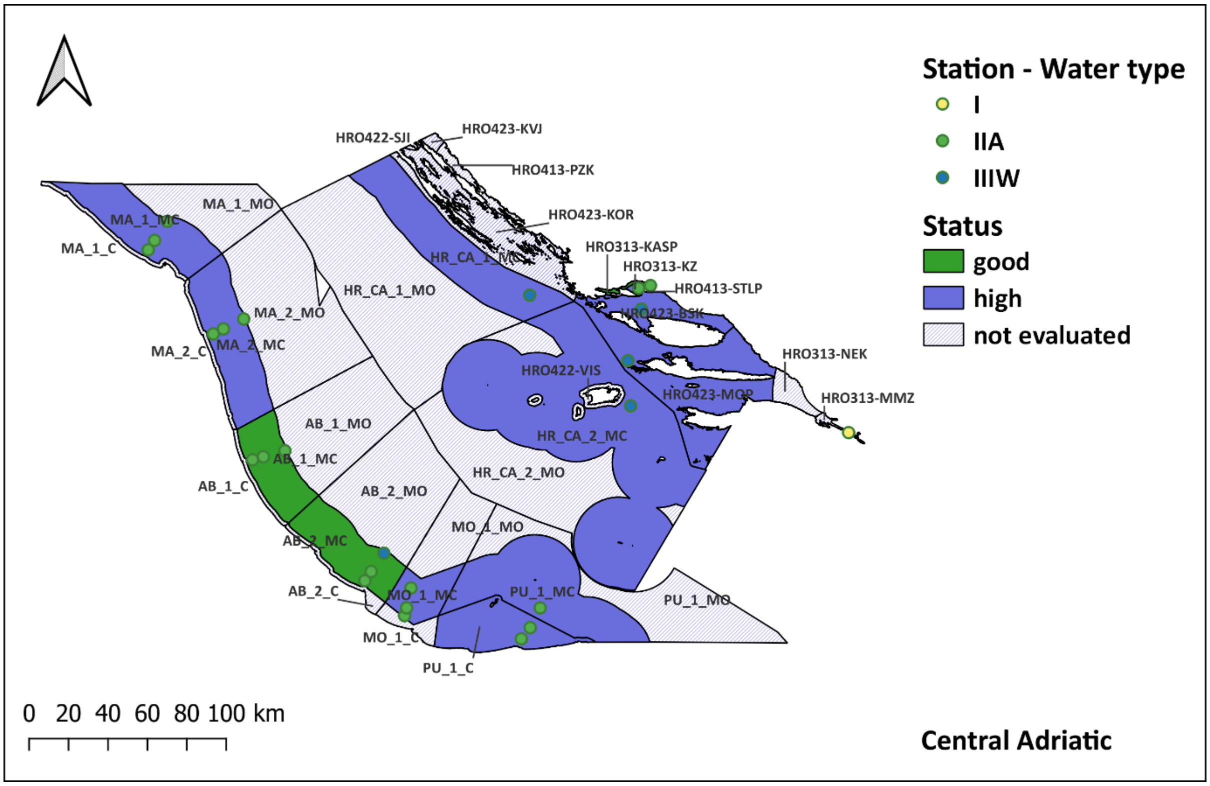

Figure ADR 5.1.2.E: The NEAT assessment results for IMAP CIs 13 and 14 in the Central Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status.

574. The overall status of IMAP CIs 13 and 14 CI14 regarding the three parameters assessed i.e. TP, DIN and chlorophyll a, on the sub-division level for CAS is High and in GES. Nine out of fourteen SAUs are classified under High status and five under Good.

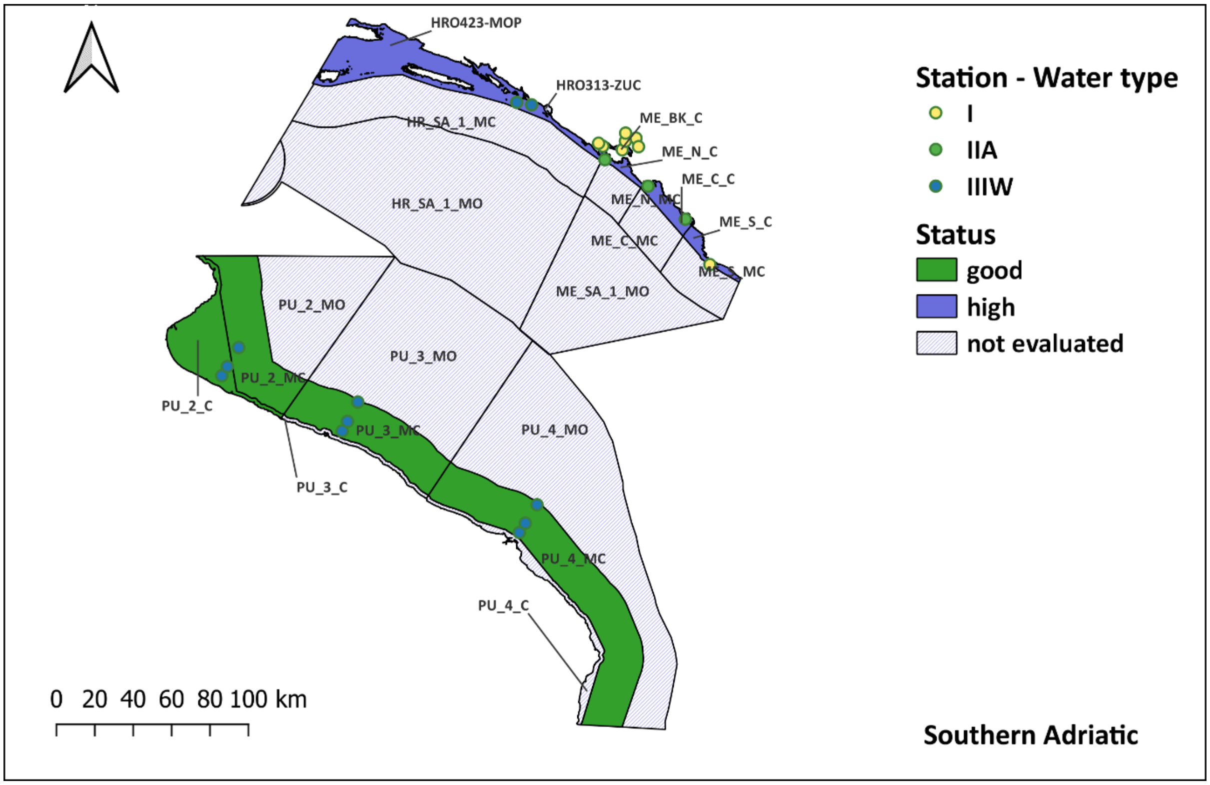

Figure ADR 5.1.3.E: The NEAT assessment results for IMAP CIs 13 and 14 in the South Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status. Blank area corresponds to no available data.

575. The overall status for CIs 13 and 14 on the sub-division level for SAS, CI 14 regarding the three parameters assessed i.e. TP, DIN and chlorophyll a, is in GES. Four out of 14 SAUs are classified under Good conditions the rest under High. The Good status is observed along the Italian coast.

5.1.3 The IMAP Environmental Assessment of the Central Mediterranean (CEN) Sub-region

576. As already explained, at the stage of the present document finalization for consideration of the Meeting of CorMon on Pollution Monitoring, the assessment findings for the Alboran Sea, as the Syb-division of the WMS, and the Levantine Sea, as the Sub-division of the AEL, were finalized. The preparation of the remaining assessments at the level of the Subdivisions in the AEL, WMS, and CEN is foreseen within the finalization of the IMAP Pollution Cluster thematic assessments by applying the Simplified methodology based on G/M comparison.

5.1.4 The IMAP Environmental Assessment of the Western Mediterranean Sea (WMS) Sub-region

a) <u>The Alboran Sea Sub-division</u>

577. The results of CI 14 assessment provided by the application of the Simplified G/M assessment methodology on the COPERNICUS satellite-derived Chl*a* are shown by the respective colour in the maps included in Figures ALBS 5.1.1.E and 5.1.2.E.

578. The maps depict the acceptable and non-acceptable statuses i.e. likely GES/non GES assigned at the level of SAUs which are set in the Alboran Sea Sub-division.

579. As explained in Section 4, the likely GES corresponds to the RC conditions class (column oN10 in Tables 4.2.4.4 and 4.2.4.5), as well as to the class between the RC values and the G/M boundary limit, set as the back transformed 85th percentile of normalized distribution (i.e., blue coloured cells in the last G_N.G.oN85 column in Tables 4.2.4.4 and 4.2.4.5), which is depicted in blue coloured SAUs in Figure ALBS 5.1.1.E. The likely non GES corresponds to the class above the G/M boundary limit (i.e. red coloured cells in the last G_N.G.oN85 column of Tables 4.2.4.4 and 4.2.4.5) which is depicted in red coloured SAUs in Figure ALBS 5.1.2.E.

580. The results of CI 14 assessment using the satellite derived Chl*a* data confirm that all evaluated assessment zones can be considered likely in GES, with an exception of 4 SAUs set in line with WFD in the CW assessment zone of Spain i.e. one SAU located close to the Gibraltar strait (ES060MSPF610002), two SAUs (ES060MSPF610015 and ES060MSPF610016) located in the ESPE close to the line dividing the CW to the eastern and western part of the assessment zone, and the most eastern SAU (ES070MSPF010300090) located close to the Mar Menor lagoon. The local sources of pollution are probably the main drivers contributing to the weakened status of the first and the last SAUs. Wider biogeochemical processes can contribute to the weekend status of other two SAUs.

581. The results of the present CI 14 assessment in the Alboran Sea Sub-division represent only an indication of possible GES/non GES at the level of the SAUs, whereby SAUs are not set at the same level of spatial finesse. Namely, the reliability of the assessment was negatively affected by the lack of data reported by the CPs in IMAP IS, and therefore impossibility to use the IMAP NEAT GES assessment as applied to the Adriatic Sea Sub-region.

582. The results of additional assessment performed for every satellite derived Chl*a* point of the data grid are depicted in Figure ALBS 5.1.2.E. This assessment is only indicative of the present environmental status given the high geographical variability of the biogeochemical processes at such scale (1 x 1 km).

583. However, these additional assessment results indicated the main biogeochemical, controlling processes in the Alboran Sea i.e. the impacts of the waters entering the Mediterranean through the Gibraltar Strait with different nutrient load; the accumulation of organic materials north of the Central Circulation Gyre; the influence of the returning current along the southern coast of the Alboran Sea, resulting in increased value along the Moroccan and Algerian coast; and the local influence of the Nador lagoon.

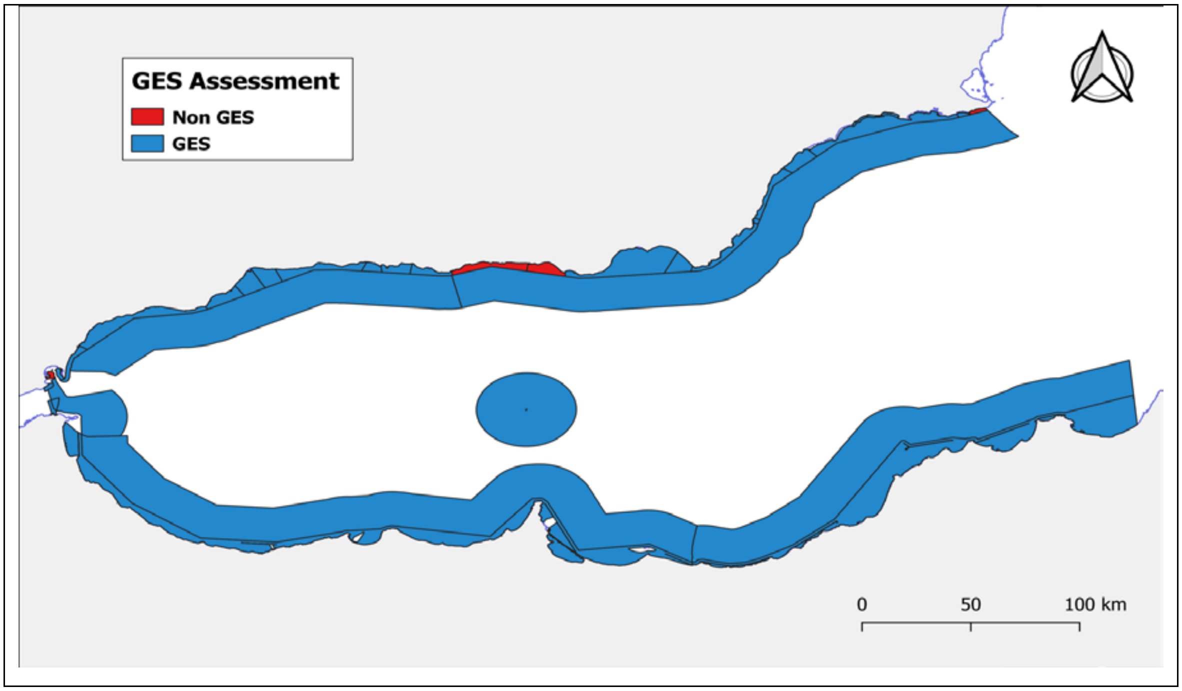

Figure ALBS 5.1.1.E: The assessment results for CI 14 in the Alboran Sea Sub-region. For part of CW for which data were reported by Spain additional evaluation was performed, as explained above, by superimposing the spatial scope of WFD water bodies with the spatial scope of CW assessment zone.

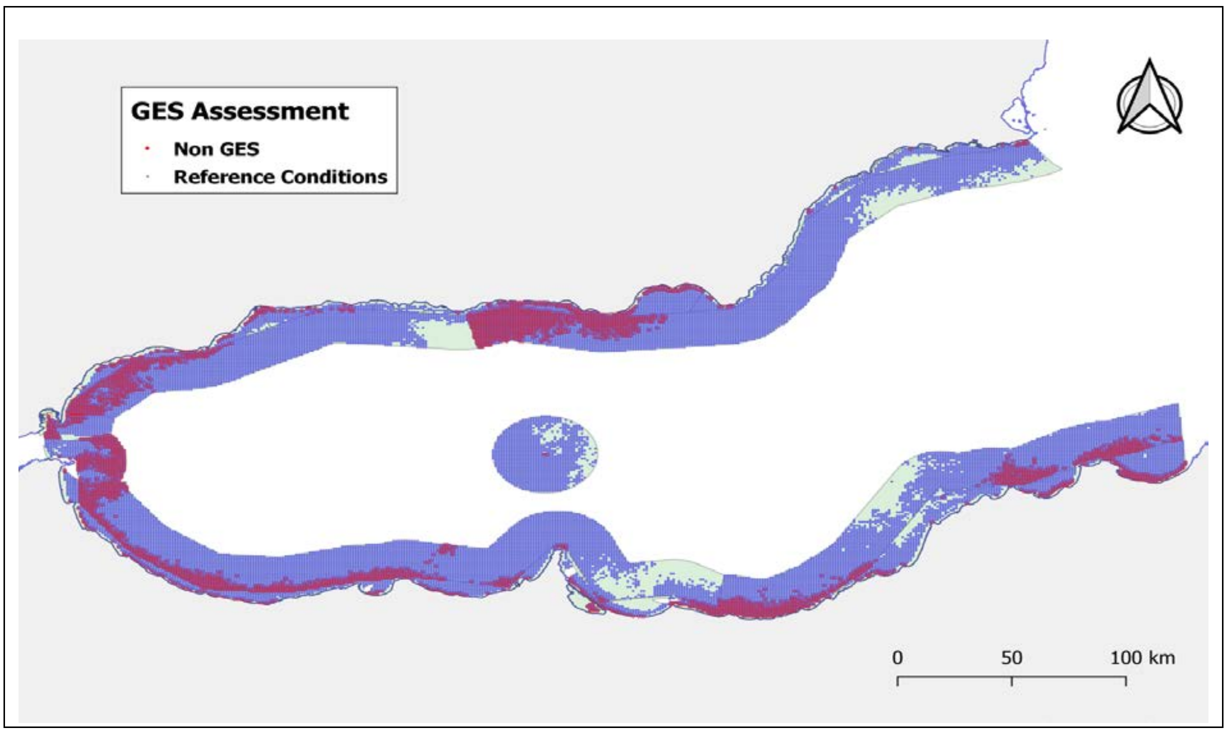

Figure ALBS 5.1.2.E: Additional assessment results for CI 14 in the Alboran Sea Sub-division by applying the simplified G/M method for satellite derived Chla points of the observation grid (1 x 1 km). Satellite derived Chl*a* data points which indicate non-GES are plotted (coloured in red), as well as Chl*a* data points which indicate the RC conditions (coloured in blue).

5.2 Key assessment findings for IMAP Common Indicator 17

5.2.1 Key findings of the IMAP CHASE+ Environmental Assessment of the Aegean and Levantine Seas (AEL) Sub-region

a) *Key findings related to the IMAP CHASE+ Environmental Assessment of CI 17 in the Aegean Sea (AEGS) Sub-division*

Assessment of Trace metals in sediments of the AEGS

584. The assessment of Trace metals in sediments is shown in Figure AEGS 5.2.1.C.

585. Regarding TM in sediments, the whole AEGS is classified as non-GES (Figure AEGS 5.2.1.C). Only 67% of the stations were in GES for TM in sediments. Therefore, by applying the decision rule agreed for CHASE + assessment methodology by the Meeting of CorMon Pollution (27 ad 30 May 2022) which recommends that only if at least 75% of the elements are in GES, the area should be considered in GES, the whole AEGS is classified as non-GES regarding TM in sediments. However, this is a result of the contribution from only 2 limited affected areas (1) the Elfesis Bay and inner Saronikos Gulf, and 2) the two stations near Aliaga and Yenisakran. When data from these affected areas, that constitute less than 1% of the AEGS, are not taken into account, then 82% of the stations (65 out of 79 stations) are in GES, and the AEGS sub-division can be classified as in GES. These 79 stations are distributed evenly across the AEGS sub-division, providing a good coverage of the sub-division.

586. The 28 stations reported by Karageorgis et al. (2020 a,b) were located in a very limited area of the Saronikos and Elfesis Gulf, that correspond to about 0.5% of the total AEGS area. Moreover, they reported only the concentrations of Pb in sediments. This emphasis of a small area could introduce a bias in the whole sub-division assessment. Therefore, for comparison, the assessment was performed without taking these stations into consideration. The assessment found that 20% of the stations were in high status, 53% in good status, 20% in moderate status, 4% in poor status and 3% in bad status. In this case, 73% of the stations were classified in-GES, and the status of the AEGS remains marginally non-GES, therefore the exclusion of these stations did not change the overall assessment of the sub-division.

587. In brief, it can be stated that regarding TM in sediments, only 2 limited affected areas were identified in non-GES in the AEGS i.e. 1) the Elfesis Bay and inner Saronikos Gulf, and 2) the area near Aliaga and Yenisakran. The AEGS, with the exception of these two areas, that constitute less than 1% of the AEGS, can be classified as in GES, as 82% of the stations (65 out of 79 stations) are in GES. These 79 stations are distributed evenly across the AEGS sub-division, providing a good coverage of the sub-division.2

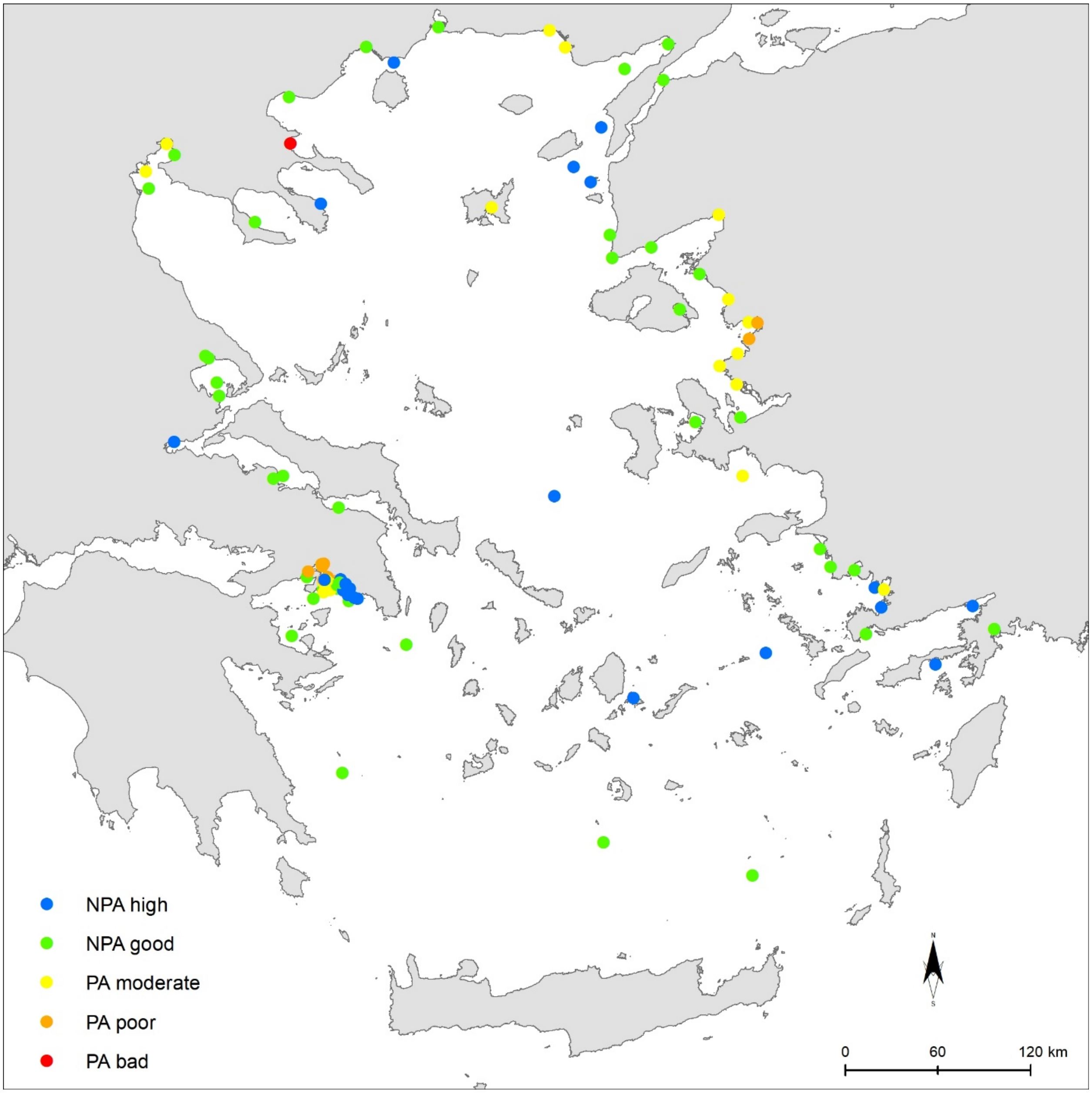

Figure AEGS 5.2.1.C. Results of the CHASE+ assessment methodology to assess the environmental status of TM in sediments in the AEGS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (CS =2.0-5.0) and stations in red - PAbad (CS > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments of the AEGS

588. The assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments is shown in Figures AEGS 5.2.2.C. and AEGS 5.2.3.C.

589. As it was explained above, there were only 21 stations with data for Σ16 PAHs in sediments, whereby for the stations with available data for Σ_{16} PAHs, the assessment performed using Σ_5 PAHs was identical to the assessment based on Σ_{16} PAHs.

590. It was not possible to classify the AEGS sub-division regarding data for Σ_{16} PAHs in sediments (Figure AEGS 5.2.2.C.). There are indications that the offshore zone is in GES while the enclosed areas might be found as non-GES. Additional data are needed to improve the assessment and delimit possible affected areas.

591. The AEGS was classified as non-GES regarding Σ_5 PAHs in sediments. Two limited affected, non-GES areas were identified i.e. 1) the Elfsis Bay and inner Saronikos Gulf and 2) the area encompassing the coast around Kucukkoy, Dikili, Candarli, Aliaga, and Yenisakran. The southern part of the AEGS can be classified as in GES, as all stations, except the two, were in high and good statuses (Figure AEGS 5.2.3.C).

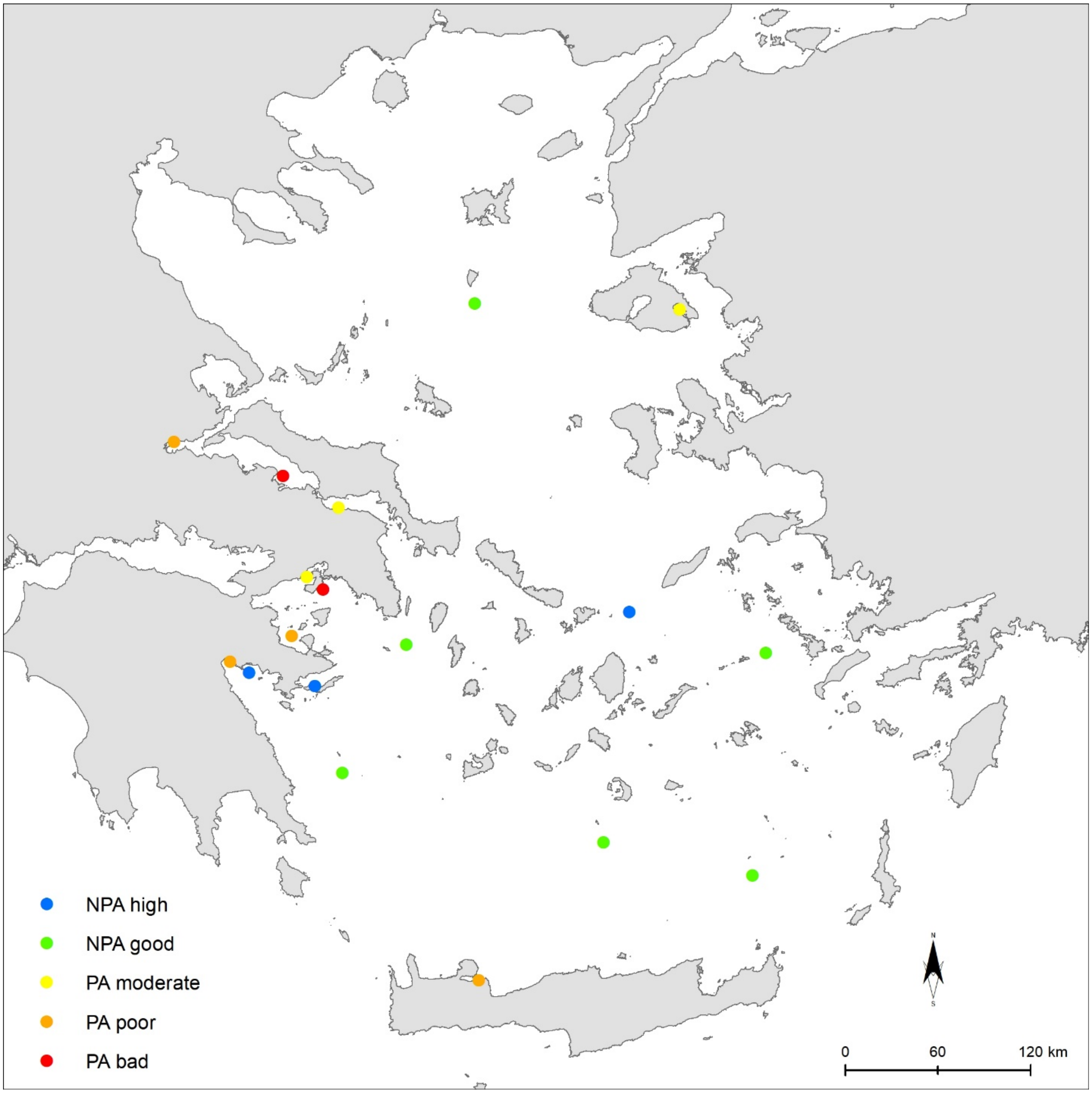

Figure AEGS 5.2.2.C. Results of the CHASE+ assessment methodology to assess the environmental status of Σ_{16} PAHs in sediments in the AEGS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

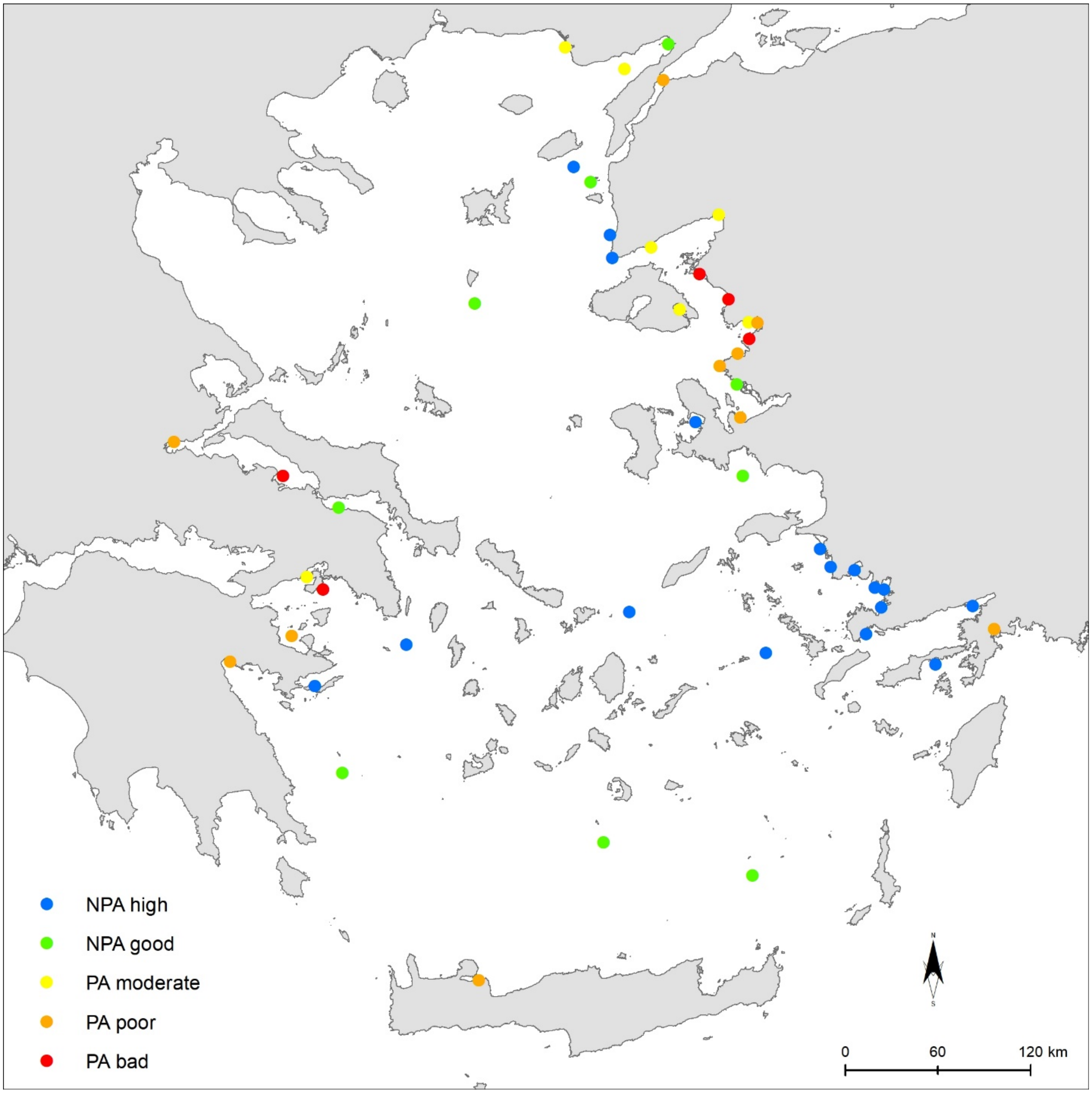

Figure AEGS 5.2.3.C. Results of the CHASE+ assessment methodology to assess the environmental status of Σ_5 PAHs in sediments in the AEGS, using AEL_BACs as thresholds. Criteria for Σ_5 PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED WG. 533/3. Here we used the sum of the individual BAC values as provided for the 5 PAHs compounds in UNEP/MED WG. 533/3 as Σ_5 PAHs_BAC. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Σ7 PCBs in sediments of the AEGS

592. The assessment of Σ_7 PCBs in sediments is shown in Figure AEGS 5.2.4.C.

593. The AEGS sub-division could not be classified regarding assessment of Σ_7 PCBs in sediments due to lack of data. An affected, non-GES area (Figure AEGS 5.2.4.C) was identified in the coast around Aliaga, Yenisakran and Candarli. The north-eastern and south-eastern coast were in-GES regarding assessment of data on Σ7 PCBs in sediments.

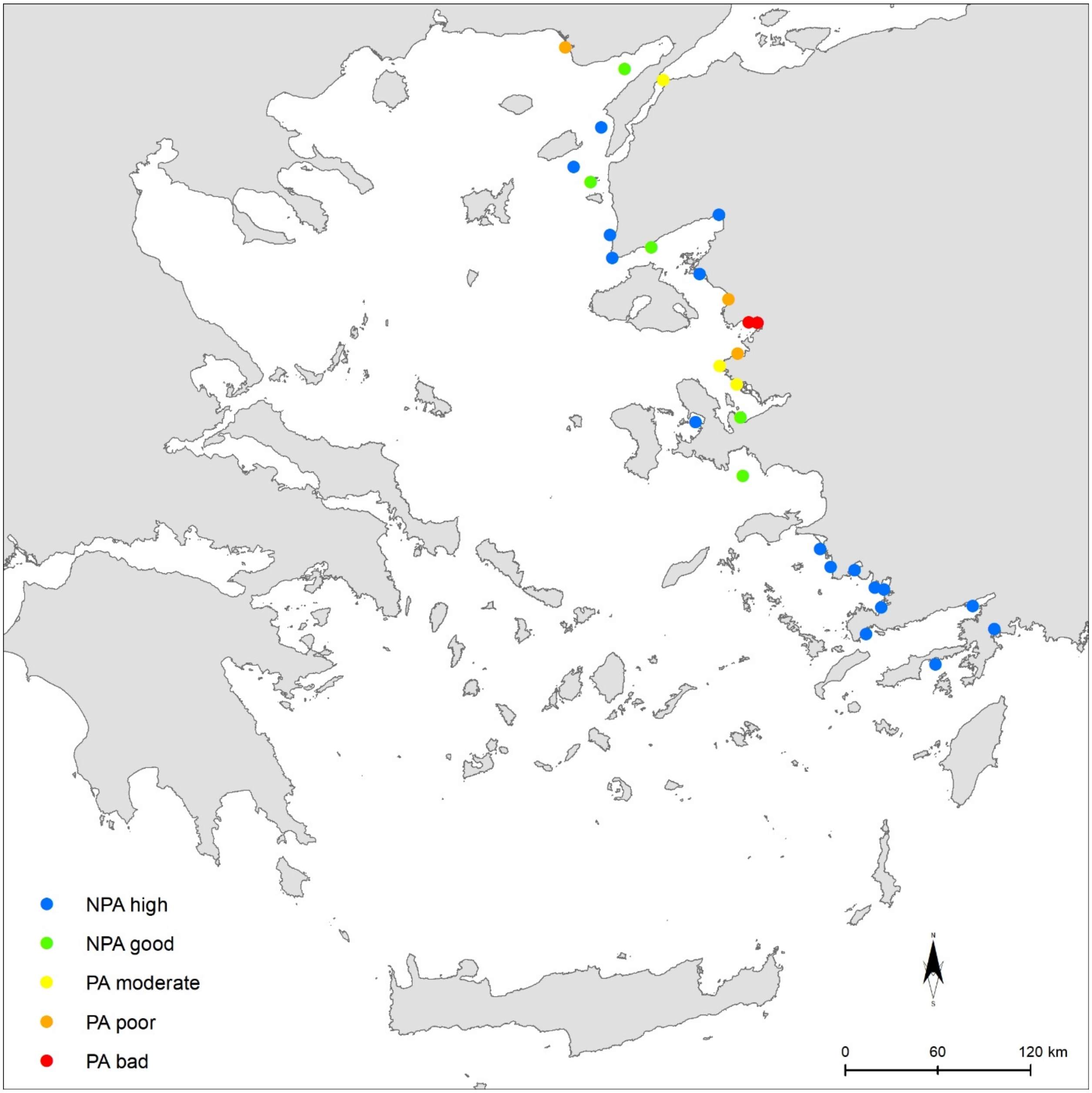

Figure AEGS 5. 2.4.C Results of the CHASE+ assessment methodology to assess the environmental status of Σ_7 PCBs in sediments in the AEGS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

<u>Assessment of Organochlorinated contaminants other than PCBs in sediments of the AEGS</u>

594. The AEGS sub-division could not be classified regarding assessment of Organochlorinated contaminants other than PCBs in sediments due to lack of data.

b) *Key findings related to the IMAP CHASE+ Environmental Assessment of CI 17 in the Levantine Sea Basin Sub-division*

<u>Assessment of Trace metals in sediments of the LEVS</u>

595. The assessment of <u>Trace metals in sediments</u> is shown in Figure LEVS 5.2.1.C.

596. The decision rule agreed for application of the CHASE + assessment methodology by the Meeting of CorMon Pollution (27 ad 30 May 2022) recommends that only if at least 75% of the stations are in-GES, the area should be considered in-GES. Therefore, the northern and eastern LEVS should be classified as non-GES regarding TM in sediments, i.e. in moderate status, as only 69% or the stations were in GES (Figure LEVS 5.2.1.C**)**. As explained in Section 4, no data were available for the southern part of the LEVS.

597. This classification is a result of the contribution from the 2 very limited affected areas i.e., (1) seven stations in the Northern Haifa Bay, and 2) three stations in the Dora region (Beirut). When data from these affected areas, that constitute less than 0.1% of the LEVS, are not taken into account, then 78% of the stations (57 out of 73 stations) are in GES, and the northern and eastern LEVS can be classified as in GES. These 57 stations are distributed evenly across the northern and eastern LEVS, providing a good coverage of this area of the sub-division.

598. In brief, it can be stated that regarding TM in sediments, non-GES stations were identified across the northern and eastern LEVS and the area was assessed as non-GES, i.e., in moderate status. No assessment could be performed for the southern LEVS as no data were available. When the contribution of two very limited affected areas i.e. (1) the Northern Haifa Bay, and 2) the Dora region (Beirut) are not taken into account, the northern and eastern LEVS can be classified as in-GES

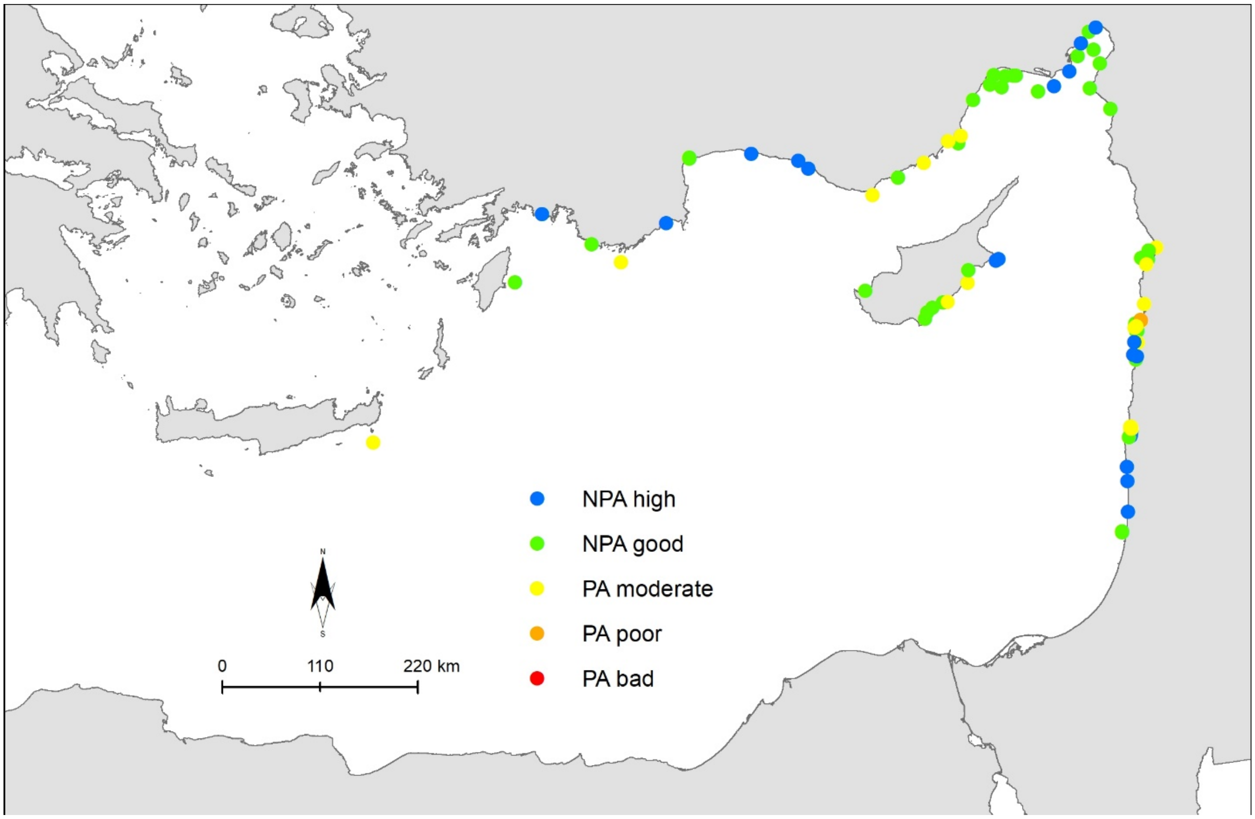

Figure LEVS 5.2.1C. Results of the CHASE+ assessment methodology application to assess the environmental status of TM in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (CS =2.0-5.0) and stations in red - PAbad (CS > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments of the LEVS

599. The assessment of Σ_{16} PAHs in sediments is shown in Figure **LEVS 5.2.2.C**.

600. There was no large specific area with non-GES status. Two small, geographically limited areas with non-GES status were identified i.e., one in Israel, at stations close to the locations of drilled wells for gas exploration (Astrahan et al., 2017) and one off in Beirut, in Lebanon. Two stations in Greece, off Lindos and Kastelorizo were also classified in moderate status.

601. Data on Σ_{16} PAHs in sediments were not distributed evenly across the LEVS, therefore the sub-division could not be assessed regarding Σ_{16} PAHs concentrations in sediments. As more than 75% of the stations were in GES it is possible to classify the areas with available data as in-GES. Given the limited data availability no conclusion could be provided on GES status at the level of the Levantine Sea Basin.

602. In brief, it can be stated that given the limited data availability, it was not possible to classify the LEVS Sub-division regarding data reported for Σ_{16} PAHs in sediments. As more than 75% of the stations were in GES, it is possible to classify the areas with available data as in-GES regarding Σ_{16} PAHs in sediments.

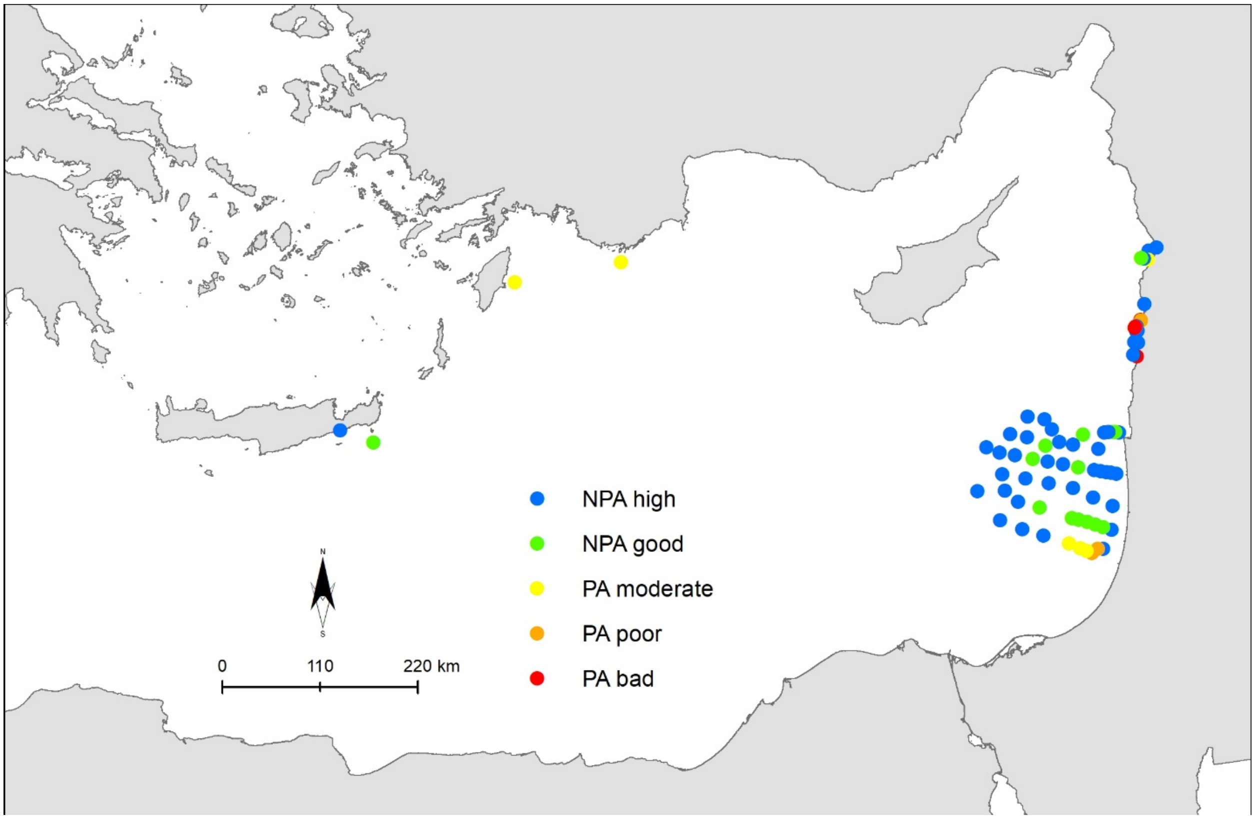

Figure LEVS 5.2.2.C Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_{16} PAHs in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

603. The assessment of Σ_5 PAHs in sediments is shown in Figure **LEVS 5.2.3.C.**

604. Out of the 97 available stations, 88 (91%) were classified as in-GES (75 stations in high status and 13 in good status) and 9 stations (9%) were classified as non-GES, 8 in moderate status and 1 in poor status (Table 4.2.2.1.3., Figure LEVS 5.2.3.C, Section 5).Therefore, the northern and the eastern part of the LEVS can be classified as in-GES regarding Σ_5 PAHs in sediments.

605. In brief, it can be stated that the northern and the eastern part of the LEVS can be classified as in-GES regarding Σ_5 PAHs in sediments.

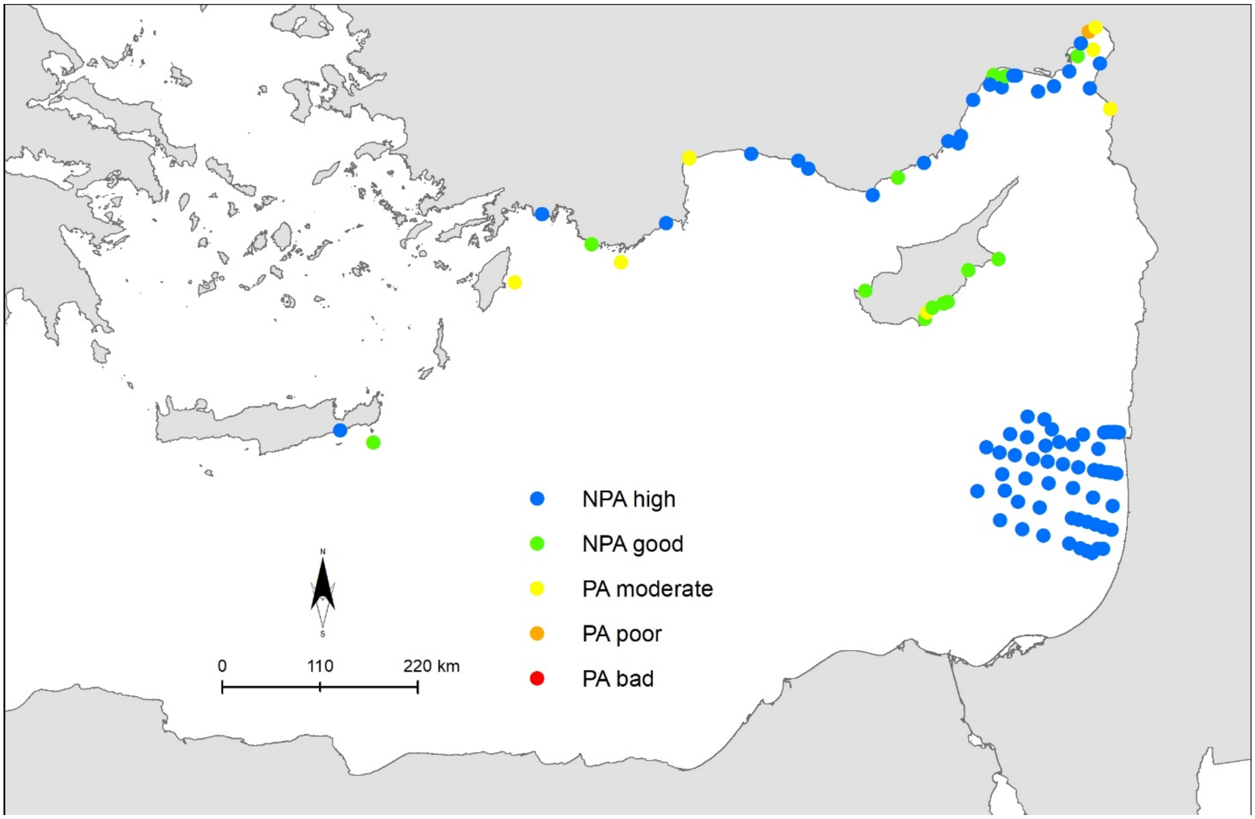

Figure LEVS 5.2.3.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ$_5$ PAHs in sediments in the LEVS, using AEL_BACs as thresholds. Criteria for Σ$_5$ PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED WG. 533/3. Here we used the sum of the individual BAC values as provided for the 5 PAHs compounds in UNEP/MED WG. 533/3 as Σ$_5$ PAHs_BAC. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Σ$_7$ PCBs in sediments and in M. Barbatus of the LEVS

606. The assessment of Σ$_7$ PCBs in sediments is shown in Figure **LEVS 5.2.4.C.**

607. The non-GES stations were located mainly at the Dora region (Beirut), as for TM in sediments, but also in additional stations. However, given the limited data availability no conclusion could be provided on environmental status of the LEVS concerning Σ$_7$ PCBs in sediments.

608. In brief, it can be stated that the LEVS sub-division could not be classified based on assessment of Σ$_7$ PCBs in sediments due to lack of data and their uneven spatial distribution for sediments and essentially no data for *M. barbatus*. A few affected areas for sediments could be indicated.

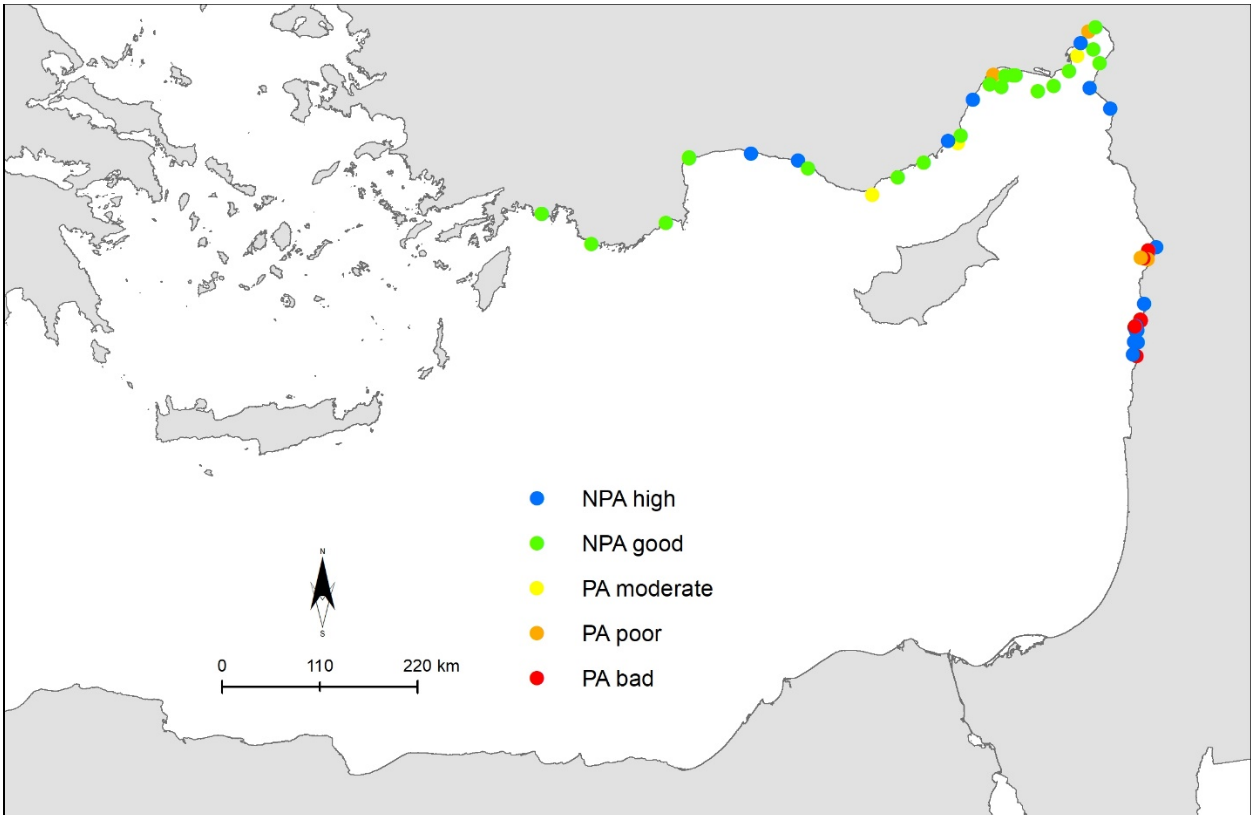

Figure LEVS 5.2.4.C. Results of the CHASE+ assessment methodology application to assess the environmental status of Σ_7 PCBs in sediments in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

Assessment of Organochlorinated contaminants other than PCBs in sediments and M. barbatus of the LEVS

609. It can be concluded that the LEVS Sub-division could not be classified based on assessment of organochlorinated contaminants other than PCBs in sediments and in *M. barbatus*.

Assessment of Trace metals in M. barbatus of the LEVS

610. The assessment of Trace metals in M. barbatus of the LEVS is shown in Figure **LEVS 5.2.5.C.**

611. The northern and the eastern part of the LEVS can be classified as in-GES concerning TM in *M. barbatus*.

612. In brief, it can be stated that the northern and the eastern part of the LEVS can be classified as in-GES concerning TM in *M. barbatus.*

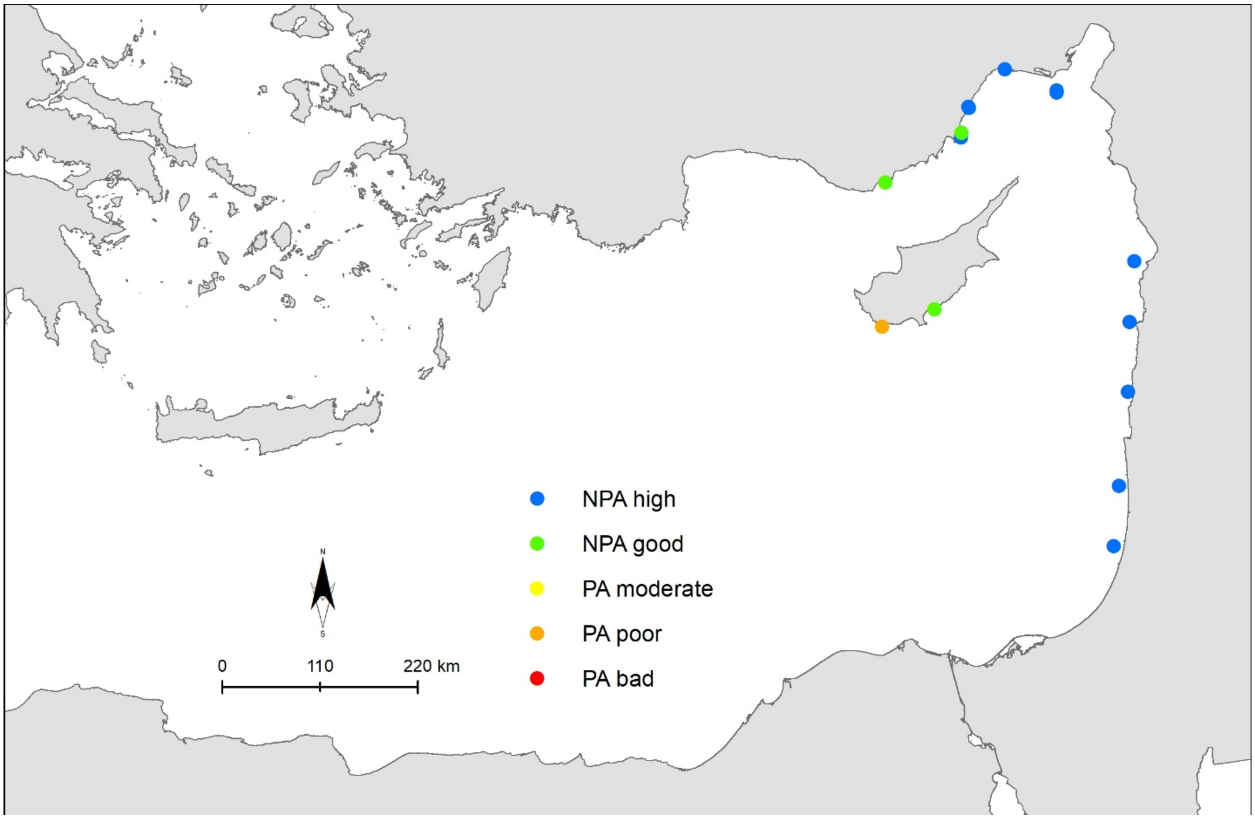

Figure LEVS 5. 2. 5.C. Results of the CHASE+ assessment methodology application to assess the environmental status of TM in *M. barbatus* in the LEVS, using AEL_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (CS =2.0-5.0) and stations in red - PAbad (CS > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES.

5.2.2 Key findings related to the IMAP NEAT GES Assessment of CI 17 in the Adriatic Sea (ADR) Sub-region

613. The aggregation of the chemical parameters data per SAU leads to the NEAT value per SAU which represents the overall chemical status of the SAUs, as shown in Table 4.3.2.4.a (4th column). It is clear that the above described non-GES classifications affect the overall chemical status and 80% of the SAUs are classified as in GES (High or Good), while 20% of the subSAUs are classified under moderate status.

614. The integration of SAUs data per chemical parameter (Table 4.3.2.4.a, bold lines), shows that: i) The NAS subdivision suffers from Hg contamination (moderate status) in sediments and mussels and PCBs (poor status) contamination in sediments; ii) The CAS sub-division suffers from Hg (poor status) and PCBs (moderate status) contamination in mussels; iii) Finally, the SAS sub-division is affected by Pb (moderate status) and PCBs (moderate status) contamination in mussels.

615. In Table 4.3.2.4.b the NEAT assessment results are aggregated per habitat (sediments, mussels). It is apparent that both the sediments and the mussels matrices are equally affected by chemical contaminants with 27% and 24% of Sub-SAUs classified as non-GES respectively., All other cases are classified in GES (High, Good status).

616. With the exception of TM in sediments, based on the availability of data for contaminants as delivered by the CPs in the Adriatic Sea sub-region, the present integrated assessment status results produced by applying the NEAT tool on the sub-division (NAS, CAS, SAS) and/or the Adriatic sub-Region level (shown in Tables 4.3.2..4.a and 4.3.2.4. b; UNEP/MAP – MED POL, 2023) can only be considered indicative. This is related to the fact that several SAUs either lack data or the countries eventually decided not to monitor the areas that are found irrelevant for the assessment of contaminants and therefore excluded the areas where problems were not historically observed (blank cells in Tables 4.3.2.4.a and 4.3.2.4. b; UNEP/MAP – MED POL, 2023).

617. The results of the assessment findings provided per contaminants of EO9/CI 17 without aggregation per habitat, i.e. sediment and biota, as presented in Table 4.3.2.4.a (schematic presentation, UNEP/MAP - MED POL, 2023) . Also, the final GES assessment findings for all the IMAP SAUs in the Adriatic Sea, as provided in Table 4.3.2.4.a, are shown by the respective color in the maps included in the Figures ADR 5.2.1.C - ADR 5.2.3.C. The maps depict the integrated NEAT value for each sub-SAU (i.e., aggregated value for all contaminants as provided in the 4th column of Table 4.3.2.4.a).

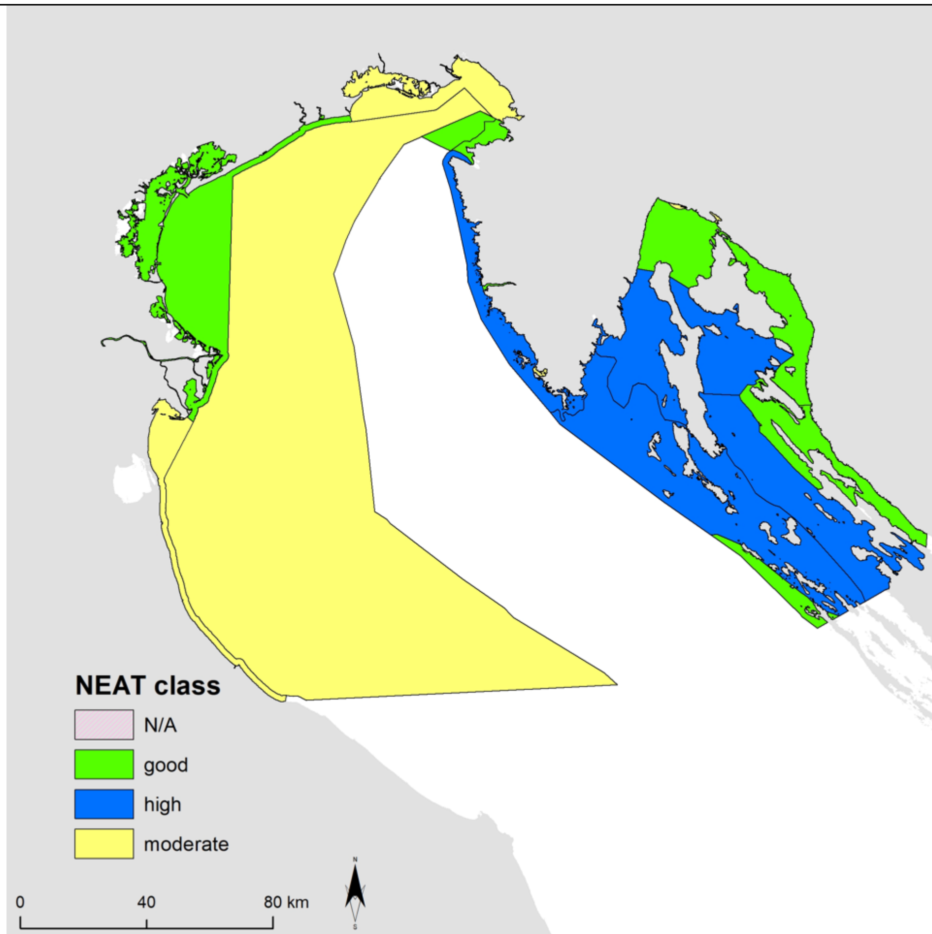

Figure ADR 5.2.1.C: The NEAT assessment results for IMAP CI17 in the North Adriatic Sea. Aggregation of all contaminants per sub-SAU. Blank area corresponds to no available data/decision on not establishing monitoring.

618. When all contaminants are aggregated, most sub-SAUs in the NAS Sub-division, are classified under High or Good status and in-GES. Six (6) sub-SAUs are classified under Moderate status, namely the three small coastal sub-SAUs HRO-0313-BAZ, HRO-412-PULP, HRO-0423-RILP in Croatia, two coastal sub-SAUs IT-Em-Ro-1, IT-Fr-Ve-Gi-1 and one offshore SAU IT-NAS-O in Italy.

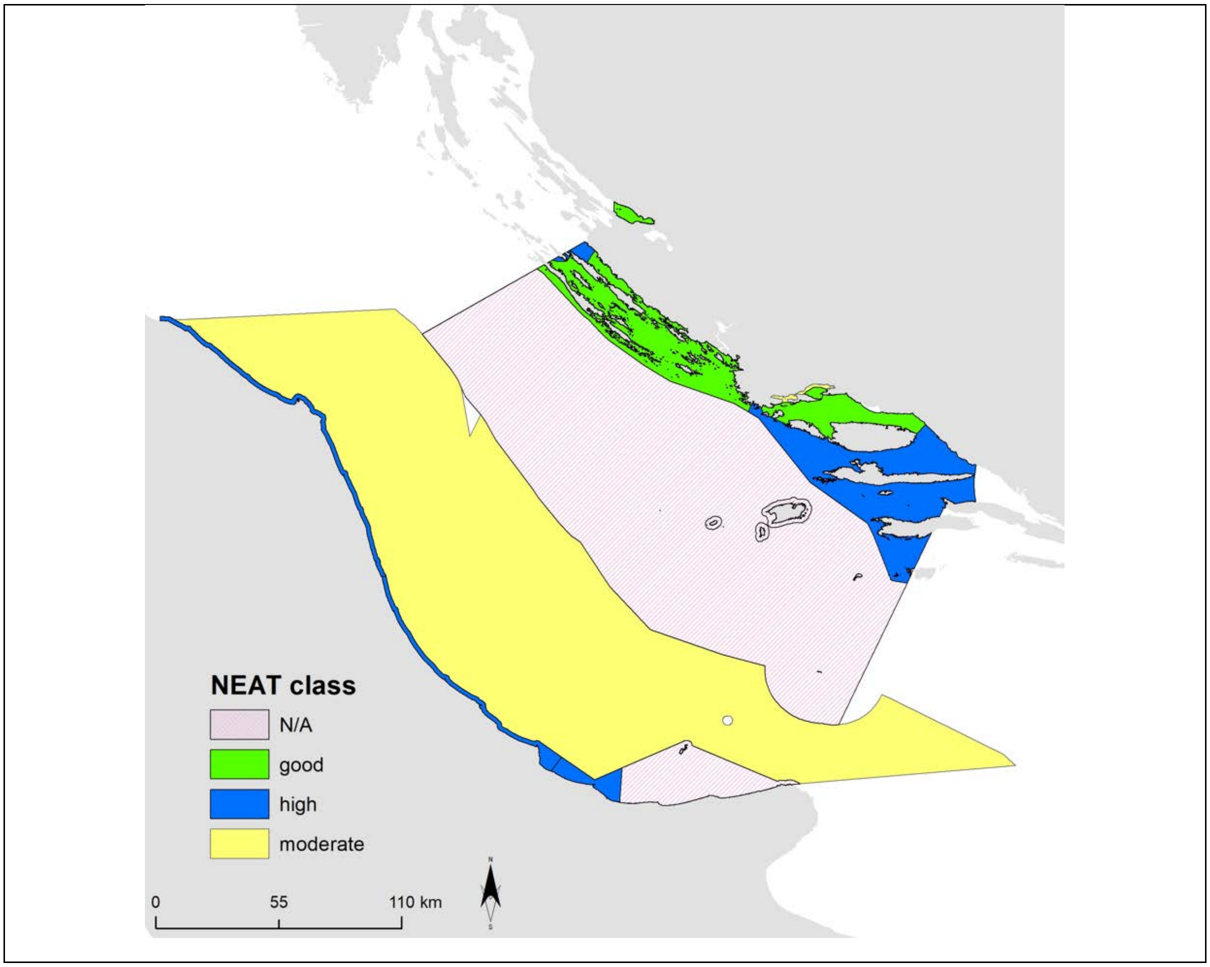

Figure ADR 5.2.2.C: The NEAT assessment results for IMAP EO9/CI17 in the Central Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status.

619. When all contaminants are aggregated, most sub-SAUs in the CAS Sub-division, are classified under High or Good status and in-GES. Only one coastal sub-SAU is classified under Moderate status, namely the coastal sub-SAUs HRO-0313-KASP, HRO-412-PULP, HRO-0423-RILP in Croatia, two coastal sub-SAUs IT-Em-Ro-1, IT-Fr-Ve-Gi-1 and one offshore SAU IT-NAS-O in Italy.

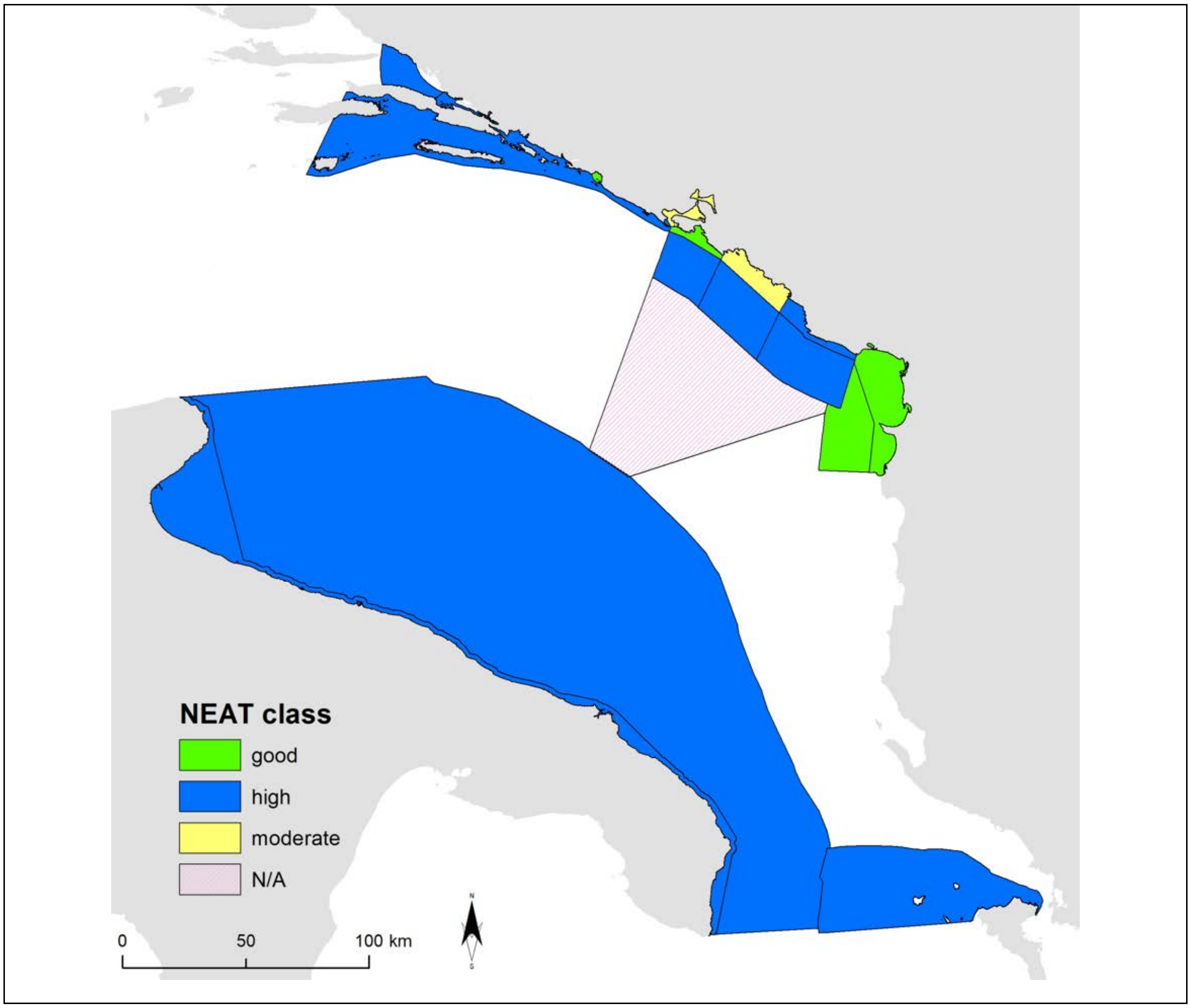

Figure ADR 5.2.3.C: The NEAT assessment results for IMAP CI17 in the South Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status. Blank area corresponds to no available data.

620. When all contaminants are aggregated, most sub-SAUs in the SAS Sub-division, are classified under High or Good status and in-GES. Only two coastal sub-SAUs are classified under Moderate status, namely the coastal sub-SAUs MNE-1-C and MNE-Kotor in Montenegro.

5.2.3 Key findings related to the IMAP CHASE+ Environmental Assessment of CI 17 in the Central Mediterranean (CEN) Sub-region

Assessment of Trace metals in sediments of the CEN

621. The assessment *of Trace metals* in sediments is shown Figure **CEN 5.2.1 C.**

622. Most of the stations (88%) were in-GES with respect to TM in sediments. However, due to the uneven distribution of the stations (sampled mostly along the coast of Malta), it was not possible to classify the environmental status to the whole sub-division nor of the CEN sub-region.

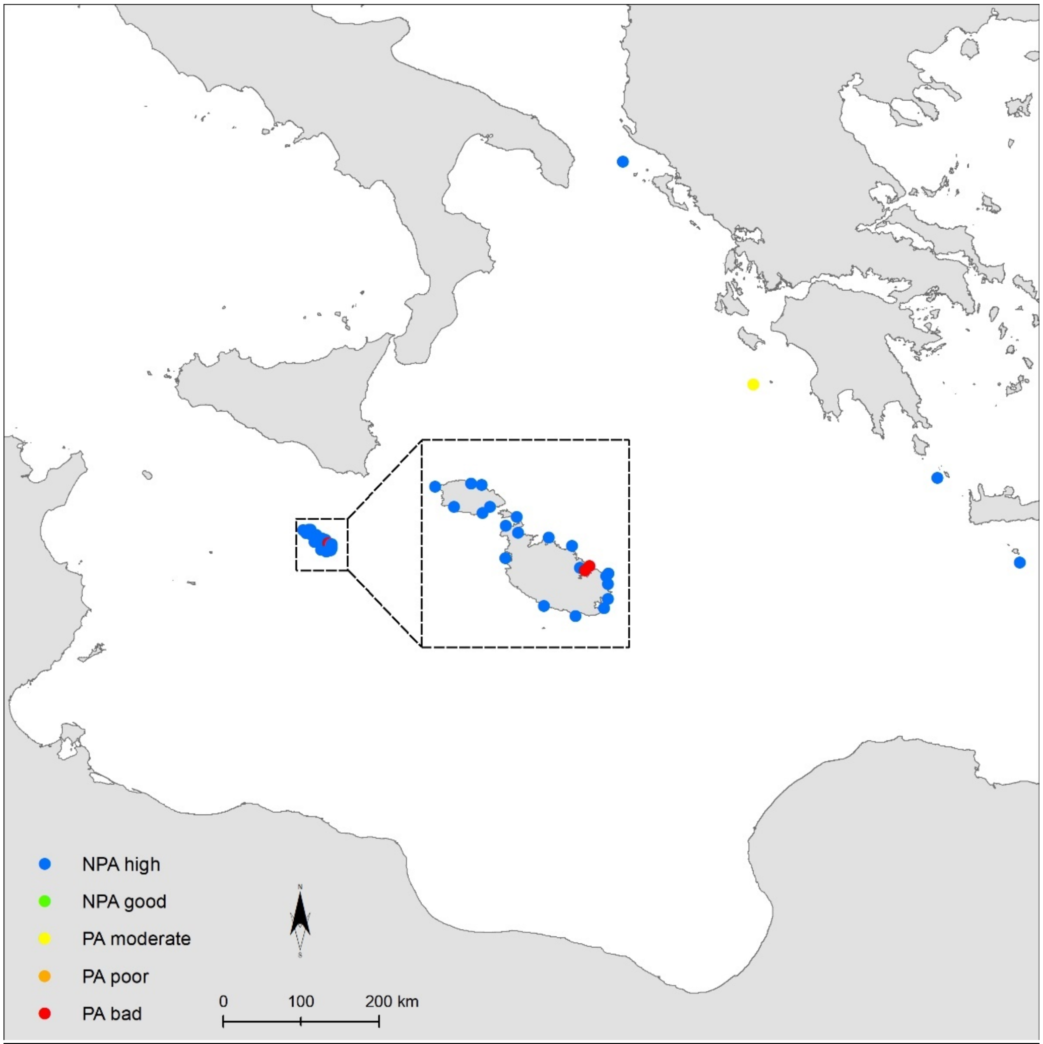

Figure CEN 5.2.1.C. Results of the CHASE+ approach to assess the environmental status of TM in sediments in the CEN, using MED_BACs as thresholds. Stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.0); Stations in yellow- PAmoderate (CS =1.0-2.0); stations in brown - PApoor (CS =2.0-5.0) and stations in red - PAbad (CS > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES. The coastal area of Malta was enlarged to improve visibility and clarity (i.e. area delimited by broken line).

Assessment of Σ_{16} PAHs and of Σ^5 PAHs in sediments of the CEN

623. The assessment of Σ_{16} PAHs and of Σ_5 PAHs in sediments is shown in Figures **CEN 5.2.2C and CEN 5.2.3.C.**

624. Due to the lack of data it was not possible to classify the environmental status of the CENS sub-divisions nor of the CEN Sub-region for Σ_{16} PAHs in sediments. Non-GES stations were located in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki.

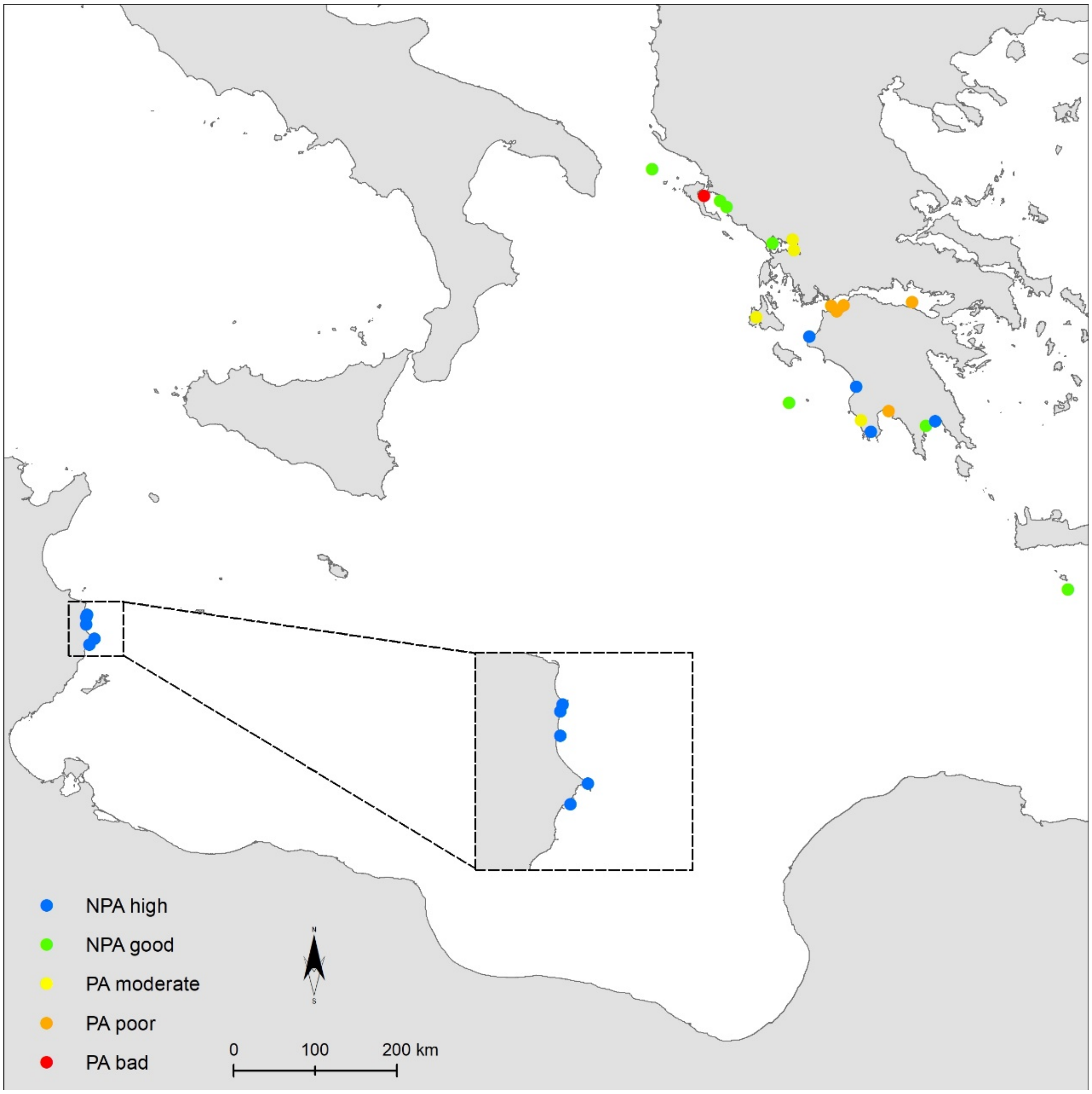

Figure CEN 5.2.2.C. Results of the CHASE+ approach to assess the environmental status of Σ_{16} PAHs in sediments in the CEN, using MED_BACs as thresholds. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES. Part of the coastal area of Tunisia was enlarged to improve visibility and clarity (i.e. area delimited by broken line).

625. Due to the lack of data and uneven distribution of the stations it was not possible to classify the environmental status of the whole sub-division nor the sub-region with respect to Σ_5 PAHs in sediments. Stations with non-GES status were located in Port il- Kbir off Valetta, Operational Wied Ghammieq, in the Gulf of Patras, Gulf or Corinth and in Kerkyraiki.

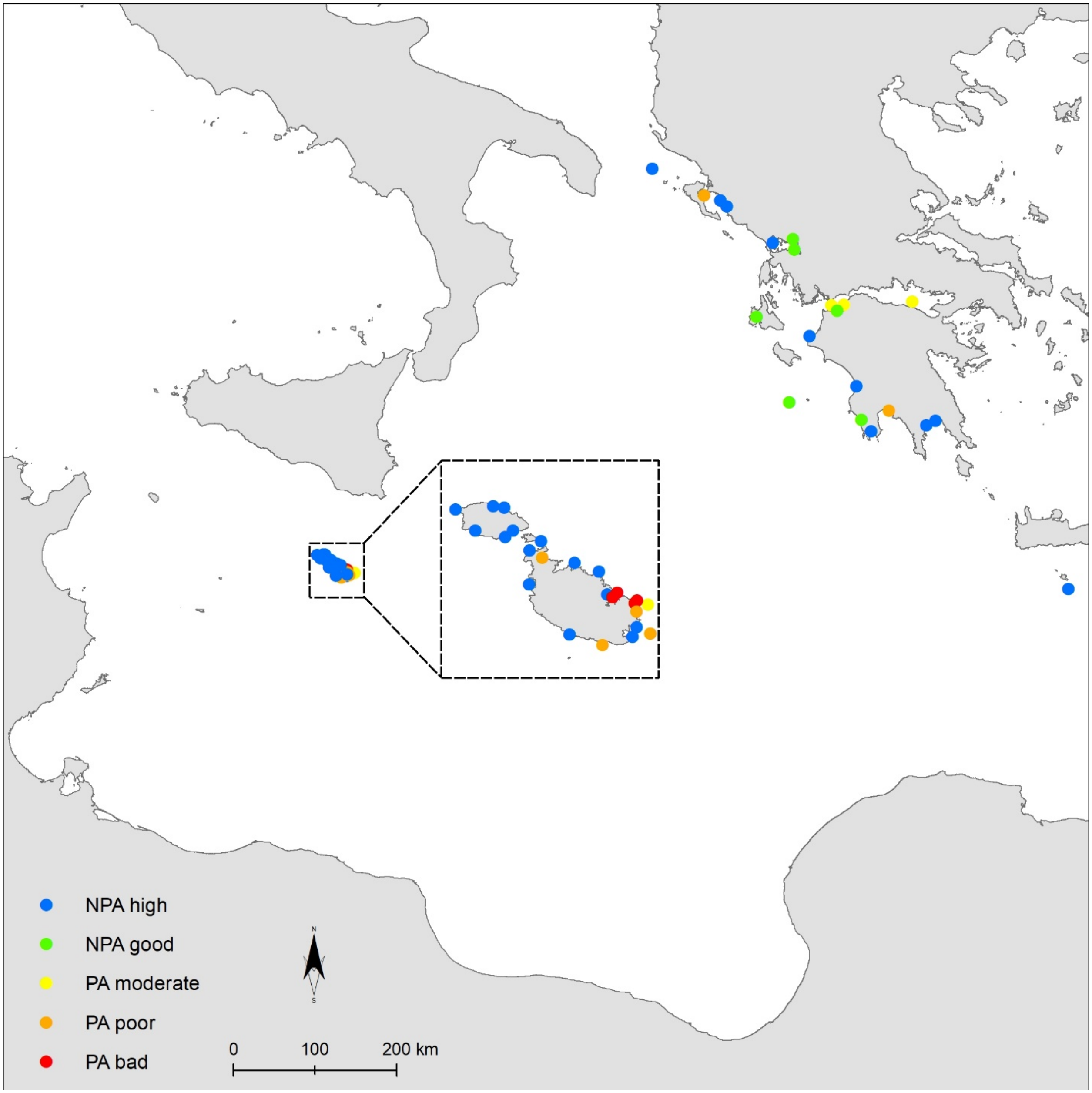

Figure CEN 5.2.3.C. Results of the CHASE+ approach to assess the environmental status of Σ_5 PAHs in sediments in the CEN, using MED_BACs as thresholds. Criteria for Σ_5 PAHs were not adopted in Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) and not addressed in UNEP/MED WG. 533/3. Here we used the sum of the individual BAC values as provided for the 5 PAHs compounds in UNEP/MED WG. 533/3 as Σ_5 PAHs_BAC. Stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-1.0); Stations in yellow- PAmoderate (CR =1.0-2.0); stations in brown - PApoor (CR =2.0-5.0) and stations in red - PAbad (CR > 5.0). Blue and green stations are considered in GES; yellow, brown and red stations are considered non-GES. The coastal area of Malta was enlarged to improve visibility and clarity (i.e. area delimited by broken line).

Assessment of Σ_7 PCBs in sediments of the CEN

626. The meager data on Σ_7 PCBs in sediments in the CEN does not allow for the regional assessment of the CEN nor of its sub-divisions.

Assessment of Organochlorinated contaminants other than Σ_7 PCBs in sediments of the CEN

627. Given only Malta reported the concentration of hexachlorobenzene in sediments, one of the mandatory organochlorine contaminants, only this compound could not be used for GES assessment.

Assessment of Trace metals in biota of the CEN

628. The meager data on biota for the CEN does not allow for the regional assessment of the CEN nor of its sub-divisions.

5.2.4 Key findings related to the IMAP NEAT Environmental Assessment of CI 17 in the Western Mediterranean Sea (WMS)

629. The aggregation of the chemical parameters data per SAU leads to the NEAT value per SAU which represents the overall chemical status of the SAUs, as shown in Table 4.3.4.4, for the ALBS (4th column). It is clear that all SAUs achieve High or Good status and can be considered in GES regarding trace metals. Similarly, the aggregation-integration within the nested scheme for the coastal zone of the Alboran subdivision (ALBS-C), results in Good GES status regarding trace metals (shown in bold in Table 4.3.4.4).

630. The integration of SAUs data per chemical parameter (Table 4.3.4.4, 1st line in bold), shows that the coastal zone of the Alboran Sea (ALBS-C) achieves High or Good status regarding trace metals with the exception of Hg in mussels for which it is classified under Moderate status. The aggregation-integration of data for the coastal zone of the Alboran sub-division (ALBS-C) results in Good GES status regarding trace metals.

631. The results of the assessment findings for the Alboran Sea provided per contaminants of EO9/CI 17 without aggregation per habitat, i.e. sediment and biota, as presented in Table 4.3.4.4 (schematic presentation, UNEP/MAP - MED POL, 2023). Also, the final GES assessment findings for the coastal IMAP SAUs in the Alboran Sea, as provided in Table 4.3.4.4 are shown by the respective color in the map included in the following Figure WMS 5.2.1.C. The map depicts the integrated NEAT value for each SAU (i.e. aggregated value for all contaminants assessed as provided in the 4th column of Table 4.3.4.4).

632. The overall status for the coastal assessment zone of the Alboran Sea is Good. Assessment is integrated for metals in sediments and biota.

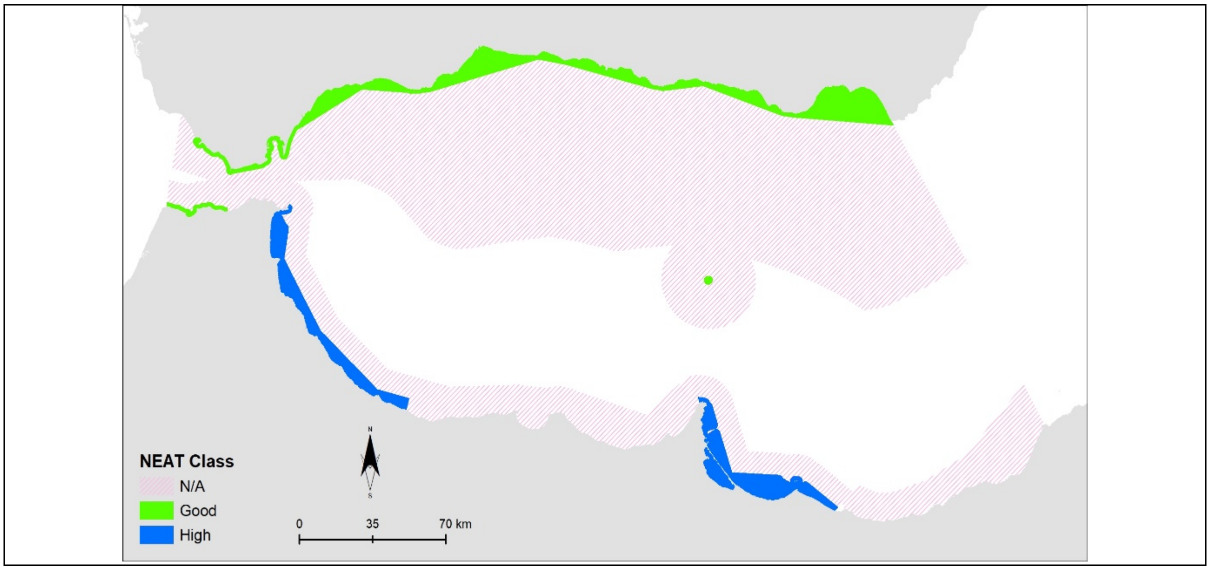

Figure WMS 5.2.1.C: The NEAT assessment results for trace metals TM in sediments and biota in the coastal assessment zone of the Alboran Sea. Assessment conducted using the xBAC GES-nGES threshold. All IMAP SAUs are in GES characterized by High or Good status. Shaded area corresponds to no available data for the assessment; The absence of some SAUs assessment might also be related to the decision of the countries to monitor areas that are found relevant for the assessment of contaminants and therefore excluding the areas where problems were not historically observed.

633. The aggregation of the chemical parameters data per SAU leads to the NEAT value per SAU which represents the overall chemical status of the SAUs, as shown in Table 4.3.4.5. for the TYRS (4th column). It is clear that all SAUs achieve High or Good status and are in GES regarding contaminants assessed. Similarly, the aggregation-integration within the nested scheme for the coastal zone of the Tyrrhenian subdivision (TYRS-C) however, results in Good GES status regarding contaminants assessed (shown in bold in Table 4.3.4.5).

634. The integration of SAUs data per chemical parameter (Table 4.3.4.5, 1st line in bold), shows that the coastal zone of the Tyrrhenian Sea (TYRS-C) achieves High or Good status regarding chemical contaminants assessed. Similarly, the aggregation-integration within the nested scheme for the coastal zone of the Tyrrhenian subdivision (TYRS-C) as a whole indicates it can be considered in Good GES status regarding chemical contaminants assessed (shown in bold in Table 4.3.4.5).

635. The results of the assessment findings for the Tyrrhenian Sea provided per contaminants of EO9/CI 17 for sediments, as presented in Table 4.3.4.5 (schematic presentation UNEP/MAP – MED POL, 2023). Also, the final GES assessment findings for the coastal IMAP SAUs in the Tyrrhenian Sea, as provided in Table 4.3.4.5 are shown by the respective color in the map included in the following Figure WMS 5.2.2.C. The map depicts the integrated NEAT value for each SAU (i.e. aggregated value for all contaminants assessed as provided in the 4th column of Table 4.3.4.5).

636. The overall status for the coastal assessment zone of the Tyrrhenian Sea is Good regarding contaminants assessed Assessment is integrated for metals, Σ_{16}PAHs and Σ_{7}PCBs in sediments.

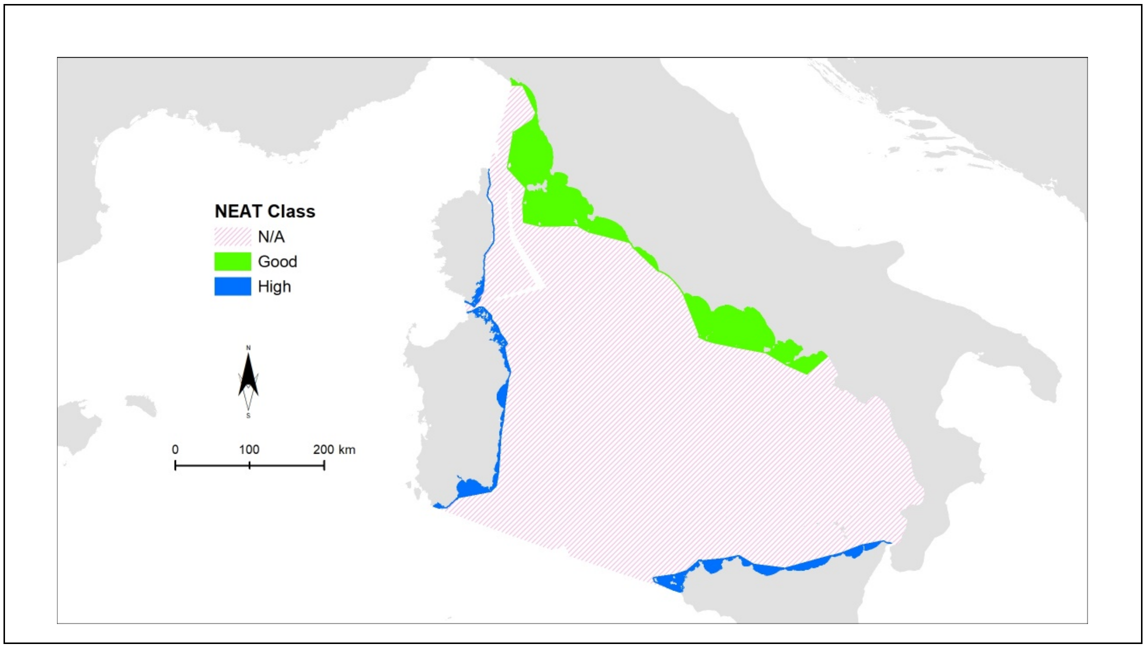

Figure WMS 5.2.2.C: The NEAT assessment results for trace metals TM, Σ_{16}PAHs and Σ_7PCBs in sediments in the coastal assessment zone of the Tyrrhenian Sea. Assessment conducted using the xBAC GES-nGES threshold. All IMAP SAUs are in GES characterized by High or Good status. Shaded area corresponds to no available data for the assessment; The absence of some SAUs assessment might also be related to the decision of the countries to monitor areas that are found relevant for the assessment of contaminants and therefore excluding the areas where problems were not historically observed.

637. The aggregation of the chemical parameters data per SAU in the CWMS leads to the NEAT value per SAU which represents the overall chemical status of the SAUs, as shown in Table 4.3.4.6 (4th column). and Figure WMS 5.2.3.C. for the CWMS. It is clear that all SAUs achieve High or Good status and are in GES with the exception of SAU IT-CWM-C where only sediments are monitored, and the overall status is moderate regarding contaminants assessed.

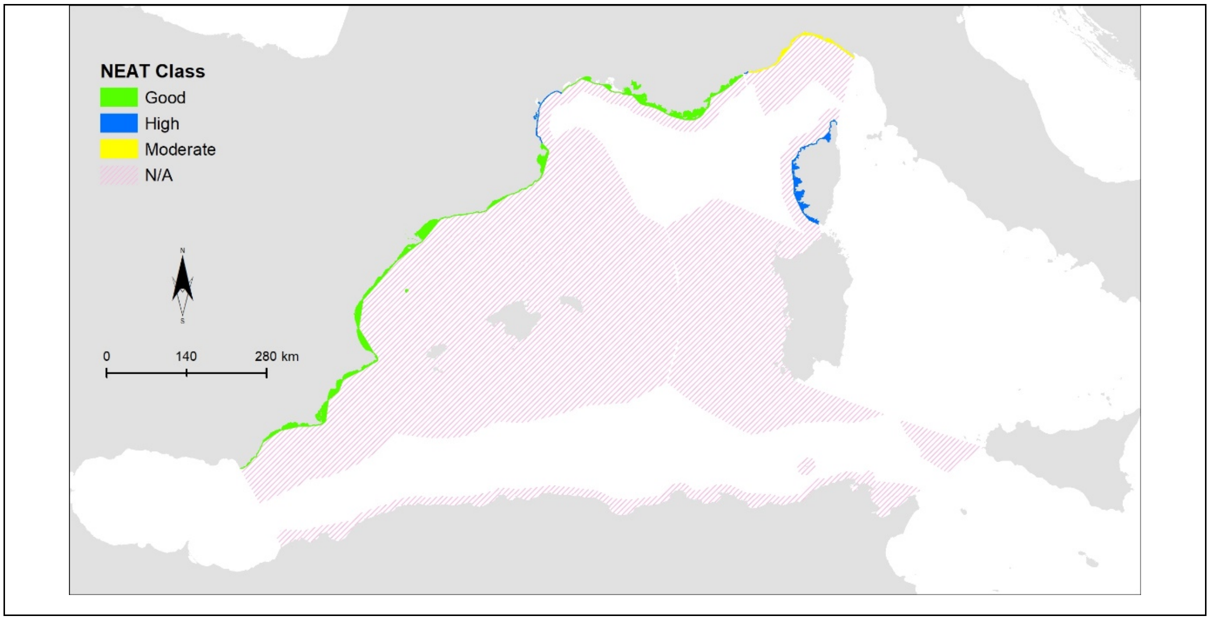

Figure WMS 5.2.3.C. The NEAT assessment results for trace metals TM, Σ_{16}PAHs and Σ_7PCBs in sediments and mussels in the SAUs of France and Spain and in sediments in the SAU of Italy in the CWMS. Assessment conducted using the xBAC GES-nGES threshold. All IMAP SAUs are in GES characterized by High or Good status except sediments assessment in IT-CWM-C which shows moderate status. Shaded area corresponds to no available data for the assessment; The absence of some SAUs assessment might also be related to the decision of the countries to monitor areas that are found relevant for the assessment of contaminants and therefore excluding the areas where problems were not historically observed.

638. Based on the availability of data for contaminants as delivered by the CPs in the Western Mediterranean Sea sub-region, the present integrated assessment status results produced by applying the NEAT tool on the sub-divisions ALBS and TYRS (shown in Tables 4.3.4.4; 4.3.4.5; UNEP/MAP – MED POL, 2023) can only be considered as an example of how the tool works. This is related to the fact that offshore SAUs lack of data, hence integration is meaningful only up to the 2nd level, i.e. the coastal assessment zone (ALBS-coastal and TYRS-coastal) [74]. Furthermore, several coastal SAUs lack data or the countries eventually decided not to monitor the areas that are found irrelevant for the assessment of contaminants and therefore excluded the areas where problems were not historically observed (blank cells in Tables 4.3.4.4; 4.3.4.5 and 4.3.4.6; UNEP/MAP MED POL, 2023).

5.3 Key assessment findings for IMAP Common Indicator 18

639. In the 2017 MED QSR, the results were visualized in 3 figures, including use of Mediterranean BACs and EACs as approved by Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20). The figures depicted LMS-NRR (Neutral red retention) in mussel, AChE in mussel gills and digestive gland and MN in mussel haemocytes.

640. Due to absence of any data reporting by the CPs, data for present assessment were retrieved from the scientific literature as explained above in Section 4.

[74] Given lack of data for some SAUs, integration at a higher level that also includes these SAUs makes the uncertainty high.

641. Figures 5.3.1 and 5.3.2 depict the sampling areas. Figure 5.3.1 shows the whole Mediterranean Sea, while Figure 5.3.2 shows in detail the study areas off eastern Algeria and Tunisia, where many of the reviewed studies were performed.

Figure 5.3.1. Areas of study for biomarkers, reviewed in the recent (since 2016) scientific literature for the Mediterranean Sea. When no coordinates were presented in the papers, the general area was marked in the map.

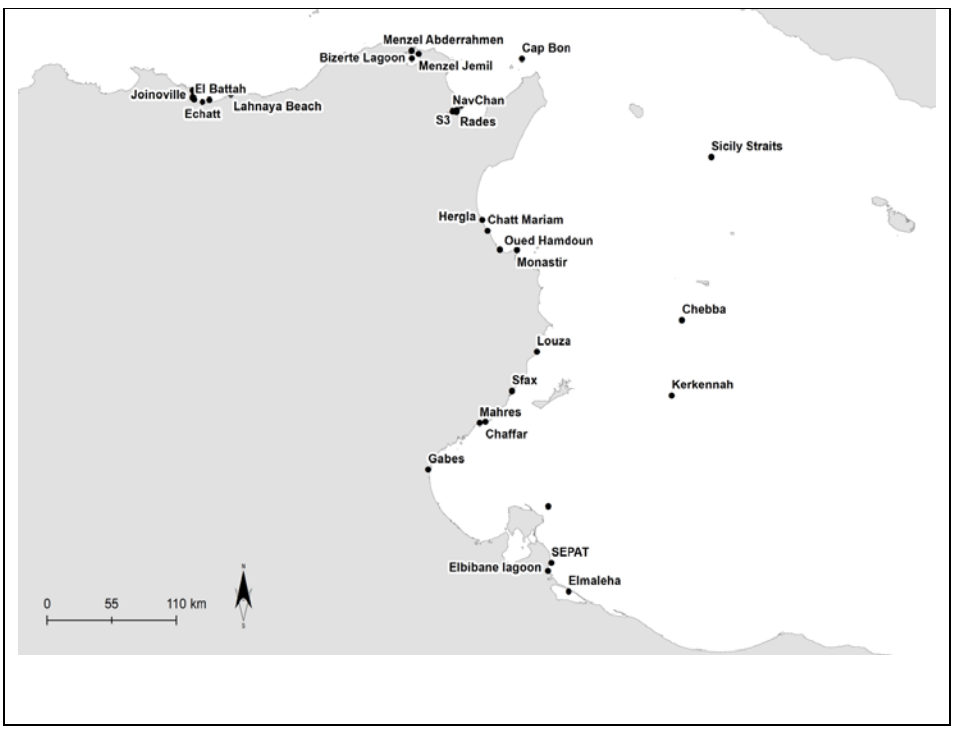

Figure 5.3.2. Detailed map of the study areas for biomarkers reviewed in the recent (since 2016) scientific literature for eastern Algeria and Tunisia coasts. Many stations were occupied in this area of the Mediterranean Sea.

642. Twenty-four studies were retrieved from the scientific literature as follows: 4 studies from Algeria (WMS), 1 from Egypt (AEL), 5 from Italy (2 from WMS, 1 from ADR, 1 from CEN and one from FAO zone 37), 5 from Spain (WMS), 7 from Tunisia (2 from WMS, 2 from CEN and 3 with data from both the WMS and CEN), and 2 from Türkiye (AEL).

643. The sub-region most represented is the WMS, followed by the CEN. In the CEN all studies except one were performed in Tunisia. There was one study from the ADR and three in the AEL.

644. The monitoring species, *M. galloprovincialis and M. barbatus*, appeared in 5 and 4 studies, respectively. In addition, 10 fish species, 6 mollusc species and 2 polychaeta species were also studied.

645. Of the mandatory biomarkers as defined in in the DDs and DSs for IMAP CI-18, AChE appeared in 13 studies, MT in 5 studies (2 with molluscs, 2 with fish and one with a polychaete species), MN in 2 and LMS-NRTT in 1 study.

646. Data from studies cannot be compared to BAC and EACs values as agreed by Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20) because they were not measured in the specific tissue of *M. galloprovincialis*.

647. The most common additional biomarkers measured in the reviewed studies were: CAT (15 studies), MDA (12 studies), GST (11 studies), SOD (9 studies), and GPx (8 studies).

648. The anthropogenic stressors identified were: Trace metals (10), Plastic/microplastic (8), non-specific (4), PAHs (3), Pesticides (2), hydrocarbons (1), anthropogenic items, and one study with desalination brine as a source.

649. Drivers and pressures reported in the studies, encompassed the whole range of them: domestic and industrial discharges, agricultural and riverine runoff, fisheries, harbor and marina utilization, maritime activities, tourism. Most of the studies described the environmental conditions at the sampling areas. The exemption was for microplastics, where the source was not determined, and microplastics were considered ubiquitous in the environment.

650. Most biomarkers studied showed a response to anthropogenic stressor. In the case of microplastics, the size of the microplastic also influenced the response.

651. Studies demonstrated that, in addition to anthropogenic stressors, biomarker responses were influenced also by seasonality, tissue analyzed, spawning status, and on species identity.

5.4 Key assessment findings for IMAP Common Indicator 19[75]

5.5 Key assessment findings for IMAP Common Indicator 20

652. Further to the elaboration of available data and relevant sources of literature as provided above in section 4, the below key findings can be highlighted.

653. No data were available in IMAP IS to perform an assessment of Common Indicator 20.

654. Assessment of CI 20, based on data reported for CI 17 contaminants in biota, found that most of the measured concentrations were below the concentration limits for the regulated contaminants in the EU.

655. Examination of CI 17 data i.e. data for TM and organic contaminants per sub-regions (Table 5.5.1) showed that data for *M. galloprovinciallis* were available only for the WMS and the ADR. Values above the concentration's limits were found for only 14 data points out of 1002 (1.4%).

[75] This section is under preparation

656. Examination of the CI-17 data i.e. only data related to TM were available, per sub-regions (Table 5.5.1) showed that data for *M. barbatus* were available for the ADR (56 data points), CEN (15 data points) and AEL (213 data points). All concentrations were below the EU concentration limits.

Table 5.5.1. Number of data points extracted from IMAP-IS CI 17 database, of relevance for IMAP CI 20, are shown in black. Assessment findings are shown in red and indicate the number of data points exceeding the criteria i.e. the concentration limits for the regulated contaminants in the EU. Table is sorted by species and alphabetical order of CPs. MG – *Mytilus galloprovincialis*; MB- *Mullus barbatus*. No criteria are specified in the EU regulations for Hg and Σ_6 PCBs in *M. galloprovincialis* nor for PAHs in *M. barbatus*.

CP	Year	Species	Cd	Hg	Pb	Σ_4 PAHs	Benzo(a) pyrene	Σ_6 PCBs
Albania	2020	MG	2	2	2			2
			0		0			
Croatia	2019-2020	MG	37	35	37			19
			0		0			
France	2015, 2017-2018	MG	50	50	50	25	25	23
			0		0	0	0	
Italy	2015-2019	MG	33	170	33		53	
			0		0		0	
Montenegro	2018-2020	MG	28	28	28	21	21	21
			0		4	0	0	
Morocco	2019-2021	MG	12	12	12	6	6	
			0		0	0	0	
Slovenia	2016-2021	MG	21	21	15	12	12	
			0		0	0	0	
Spain	2015-2017,2019	MG	70	70	70	42	42	40
			0		6	6	1	
Croatia	2019-2020	MB	11	10	11			
			0	0	0			
Cyprus	2020-2021	MB	14	14	0	12	12	12
			0	1				0
Israel	2015, 2018-2020	MB	58	60				
			0	0				
Lebanon	2019	MB	14	14	14			
			0	0	0			
Malta	2017, 2019	MB	5	5	5			
			#	0	0			
Montenegro	2018	MB	8	8	8			
			0	0	0			
Türkiye (AEL)	2015	MB	25	25	25		8	
			0	0	0			

#All data were reported to IMAP-IS as below detection limit. Detection limit was higher than the EU maximum regulatory level criteria.

657. Assessment of CI 20 based on recent peer reviewed literature found 36 relevant studies. Most (25) reported concentrations of trace metals while 12 studies reported on organic contaminants. Concentrations in a wide variety of fish species were reported in 26 studies and concentrations in molluscs in 17 studies. Data on crustaceans and cephalopods were reported in 8 studies.

658. Most of the studies found that the concentrations of the contaminants were below the concentration limits for the regulated contaminants in the EU (24 studies), or if some of the contaminants were higher than regulation, risk analysis showed no risk to human health (7 studies). Only 6 studies reported on possible risk for human health from the consumption of seafood.

659. Examination of the literature data per sub-regions was performed by counting the number of times contaminants (Cd, Hg, Pb, B(a)P) and the number of group of contaminants (Σ_4 PAHs, Σ_6 PCBs, PCDD/Fs and Σ (PCDD/F and dl PCBs**))** (see Table 4.6.3) were addressed in the literature. There were 37 entries for the WMS, 25 for the ADR, 24 for the CEN and 23 for the AEL sub-region. The percentages of blue status from the total entries were high: 78, 80, 71 and 87% for the WMS, ADR, CEN and AEL, respectively. Red status was assigned to 11, 12, 8 and 11% of the entries for the WMS, ADR, CEN and AEL, respectively (Figure 5.5.1).

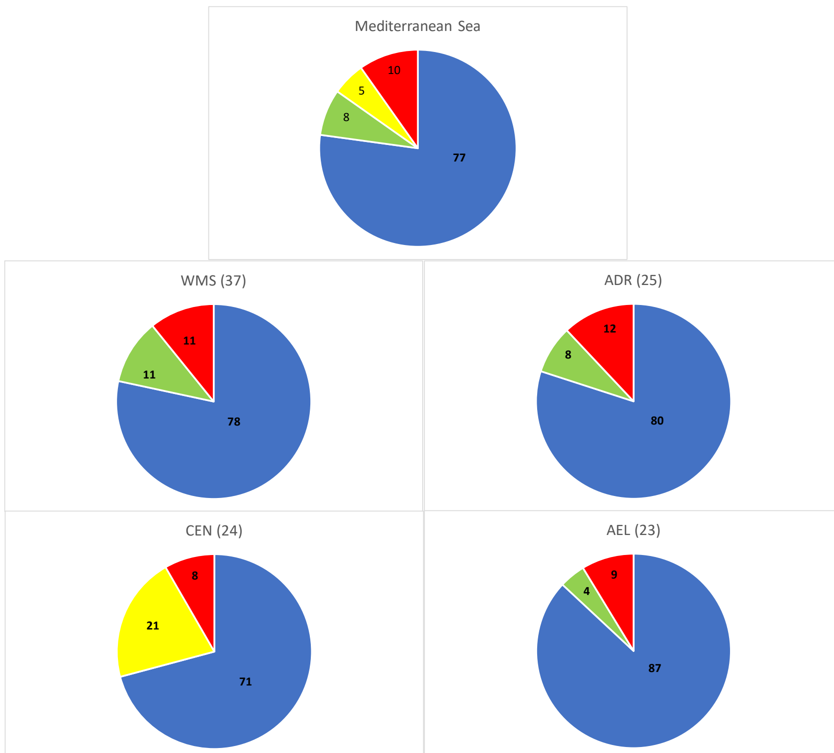

Figure 5.5.1. Assessment of CI 20 in the Mediterranean Sea and sub-regions based on recent peer-reviewed literature (UNEP/MAP MED POL, 2023). Seventeen studies from Italy had results for 2 different sub-regions. Numbers in the chart are the percentage from total entries in each status. Number in parenthesis is the number of studies for each sub-region. Blue: values below EU criteria; green: values above EU criteria but no health risk detected; yellow: values above EU criteria, risk analysis was not reported; red: above EU criteria with risk to human health.

5.6 Key assessment findings for IMAP Common Indicator 21

660. In line with the findings on the status of bathing water, as provided above in Section 4, and shown in Figures 5.6.1; 5.6.2 and 5.6.3, based on the available data, the Mediterranean bathing waters can be classified in GES (excellent, good and sufficient status) whereby percentage are higher than 85% for the CPs for which the assessment was undertaken. Only for Lebanon the percentage of stations in-GES were 74%, however, mainly due to 4 stations. The confidence of this evaluation is high for areas with sufficient

data points and bathing seasons and less so for areas with less data. Some areas of the Mediterranean could not be assessed given no data were reported.

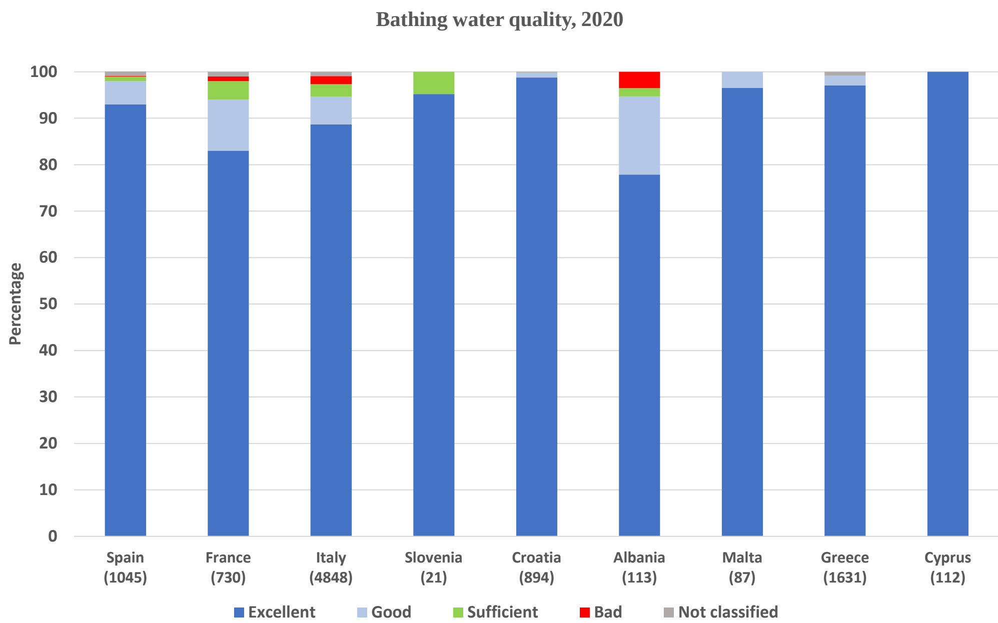

Figure 5.6.1.: Percentages of the bathing water quality assessment with respect to IMAP CI 21 in 2020 for some Contracting Parties of the Barcelona Convention. (Source: EEA, 2020). In parenthesis, number of stations.

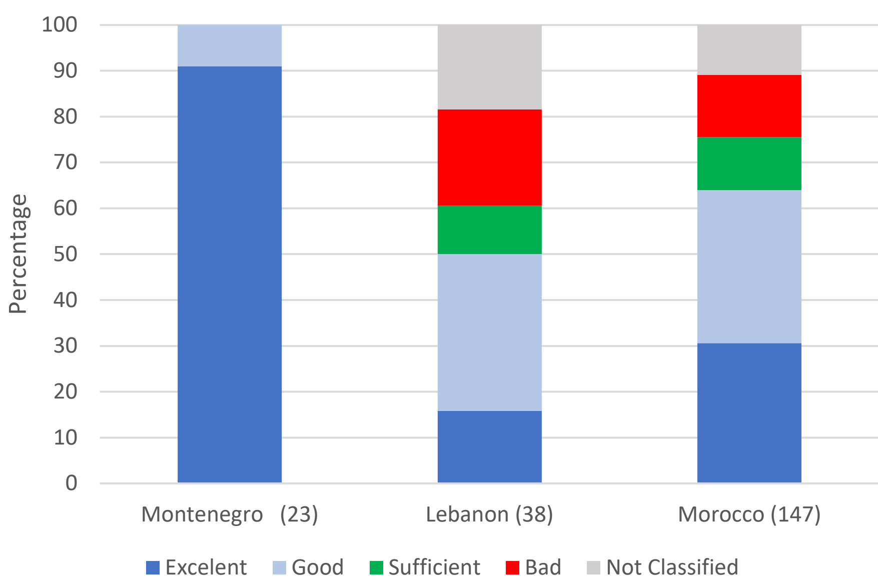

Figure 5.6.2: Percentages of the bathing water quality assessment with respect to IMAP CI 21 in 2020 for Lebanon, Montenegro and Morocco (Source IMAP InfoSystem). In parenthesis, number of stations.

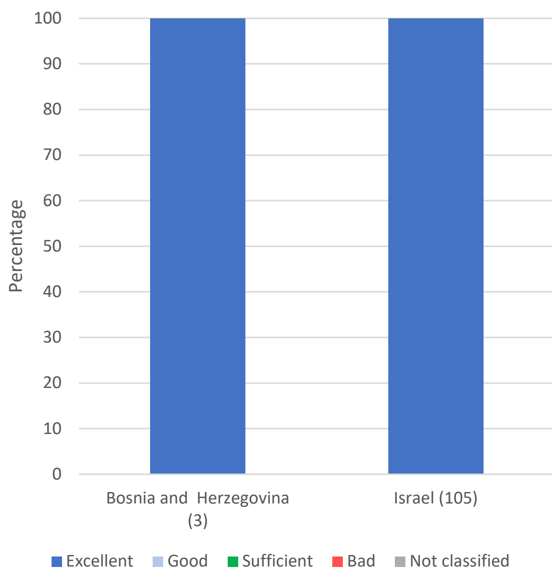

Figure 5.6.3: Percentages of the bathing water quality assessment categories with respect to IMAP CI 21 for Bosnia and Herzegovina, and Israel. (Source: IMAP InfoSystem). In parenthesis, number of stations.

661. The sub-regions with good representation were the Adriatic Sea Sub-region (ADR) with data from all the Adriatic countries (partial data for Bosnia and Herzegovina); and the Western Mediterranean Sea Sub-region (WMS) (with data from Morocco, Spain, France and Italy). The Central Mediterranean Sea Sub-region (CEN) had data from Italy, Malta and Greece, while the Aegean and Levantine Seas (AEL) Sub-region had data from Greece, Cyprus, Lebanon and Israel (partial).

662. Most of the data were available through EEA and not through IMAP IS, even up to October 31st, the cut off data for reporting for the 2023 MED QSR. It must be noted that the lack of data reporting for IMAP CI 21 into IMAP IS is a key obstacle to undertake related assessments for the preparation of the 2023 MED QSR. The evaluation of the state of the Mediterranean bathing waters should be improved by reporting additional data from the sub-regions/ sub-divisions with low quantity of data or no data reported. Therefore, the present assessment findings call on CPs to report monitoring data related to IMAP CI 21 so that they can be considered, especially in the case of the countries that have established monitoring programs for CI 21 and regularly implement them.

663. It also must be noted that sufficient data reporting i.e., 16 data points for 4 consecutive bathing seasons would allow the application of uniform assessment methodology across the Mediterranean, therefore increasing the comparability and consistency of the assessment findings.

664. Compared to the 2017 MED QSR, the current assessment includes five CPs instead of one CP with data reported to IMAP_IS, along with the CPs assessed within the EEA 2020 assessment of the state of bathing water quality. However, lack of data reporting to IMAP IS implies the use of different assessment approaches that may bring certain discrepancy. Although the present situation is better than in 2017, more data must be reported by the CPs in order to provide comparable and consistent assessment findings.

5.7 Key assessment findings for IMAP cCI 26

665. For the years 2016, 2017, 2019, 2020, 2021 and for all the 4 cetacean species considered (bottlenose dolphin, fin whale, sperm whale, Cuvier's beaked whale), all subregions are below threshold, i.e., less than 10% of the potentially usable habitat area is affected by noise events as calculated following the adapted assessment methodology.

666. For the year 2018 and for all the 4 species considered (bottlenose dolphin, fin whale, sperm whale, Cuvier's beaked whale), 3 sub-regions are below threshold of affected habitat (ADR, CEN, WMS).

667. The year that resulted in the higher percentage of habitat of cetaceans exposed to impulsive noise events was 2018. That year, the proportion of affected habitat was higher than 10% i.e. the GES/non GES boundary value/threshold in the Aegean and Levantine Sea Sub-region (AEL) considering sperm whale and Cuvier's beaked whale habitats, but was lower than 10% considering the bottlenose dolphin habitat. AEL Sub-region presents the higher likelihood to be in non-tolerable i.e., non-GES based on available data and adapted assessment methodology. See Fig 5.6.1. below.

668. Overall, for the Mediterranean Sea region, the environmental status is probably acceptable based on the present preliminary assessment findings, since the whole Mediterranean seems to comply with the 10% GES/non-GES boundary value of impacted habitat of cetaceans selected for this assessment. This conclusion is also supported by the simple coverage (without considering the habitat of cetaceans) of the Mediterranean Sea by impulsive noise events, which is below 10% for all year considered (see Figure 4.8.8 above).

669. Figures 5.7.1 and 5.7.2 provide a mapping of main assessment findings, especially highlighting potential non-GES situations found for the year 2018. It is noteworthy that the red areas highlighted in those maps do not correspond to non-tolerable, i.e., non-GES, positions, but are simply the position of all noise events for periods and areas considered (2018, all sub-regions). Tolerable or non-tolerable status is derived by dividing the extent of habitat of a species which is covered by impulsive noise events in the sub-region by the overall extent of the habitat area in that subregion. Tolerable or non-tolerable status is therefore indicated by one number (the proportion of affected habitat, in %) per sub-region plotted in the maps. Beyond this, highlighting the areas that determine the exceedance of the 10% threshold (non-tolerable, i.e. non-GES areas) during a year will be possible when the ACCOBAMS International Noise Register will be fed with enough data to allow for an optimal assessment. However, from a management perspective the way the read areas are interpreted has little importance as bringing a sub-region below thresholds will imply to take measures to reduce the extent of the red areas, wherever they are found.

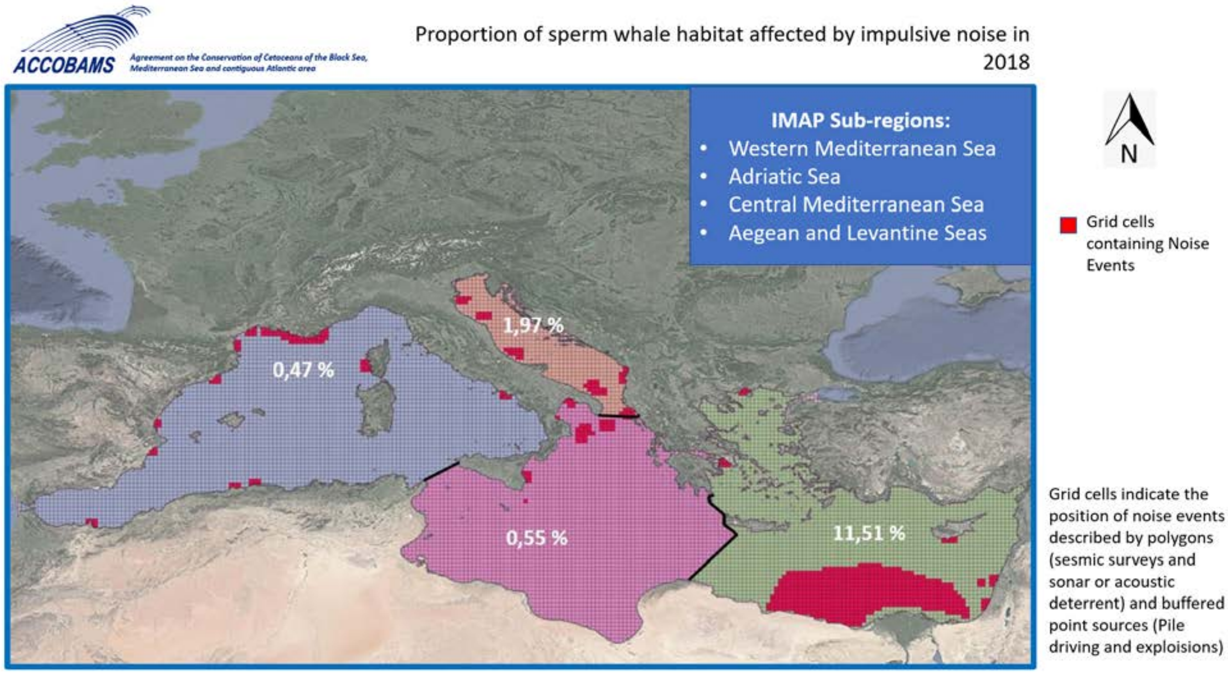

Figure 5.7.11. Percentages of habitat (PUHA) exposed to impulsive noise events, in 2018, per four IMAP Sub-regions in the Mediterranean and considering sperm whale as target species. Red grid cells indicate the position of noise events in 2018, irrespective if they are classified as GES or non-GES. The 4 sub-regions are indicated in different colours.

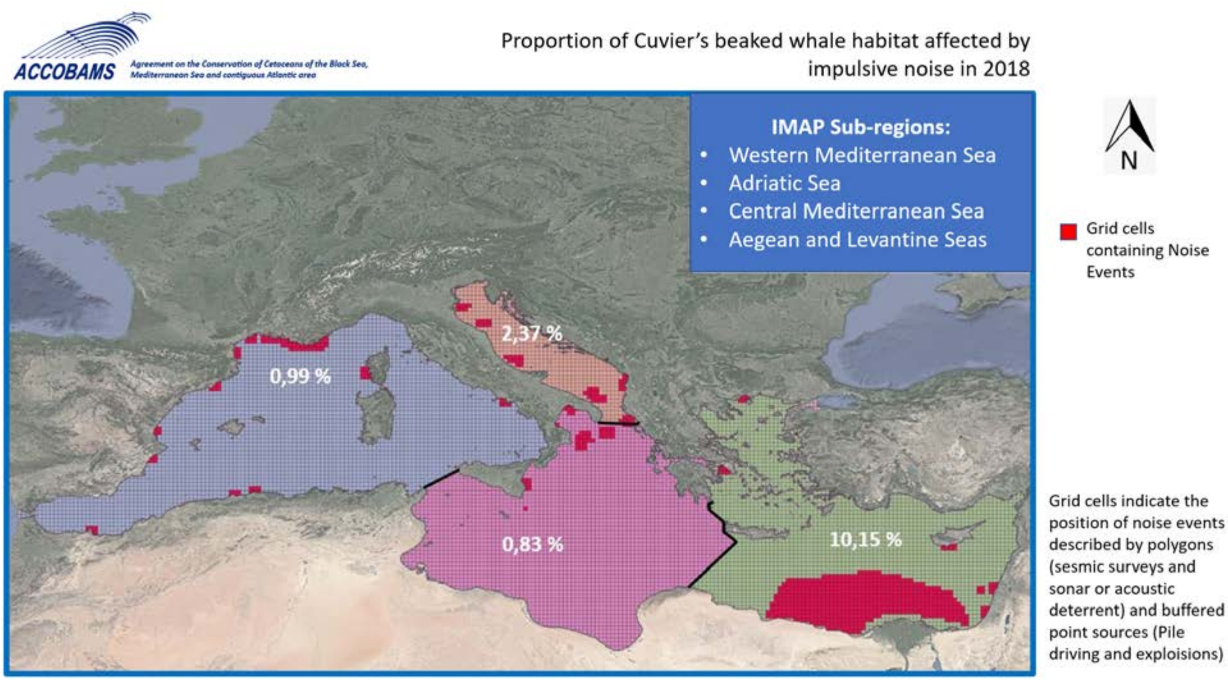

Figure 5.7.2. 2Percentages of habitat exposed to impulsive noise events, in 2018, per four IMAP Sub-regions and considering Cuvier's beaked whale habitat. Red grid cells indicate the position of noise events in 2018. The 4 sub-regions are indicated in different colours.

670. However, the assessment needs to be refined, when the INR-MED will reach a higher level of completeness, enabling to simulate the effect of the concurrent activities of impulsive noise sources through appropriate simulation techniques (including acoustic modelling), and enabling to apply the optimal methodological framework as elaborated in Section 2.

5.8 Key assessment findings for IMAP cCI 27

671. The overlap between continuous noise (median noise in July 2020) and the habitat of cetacean species clearly shows the exceedance of the 20% boundary value/threshold of the habitat area affected by continuous low frequency noise in the Western Mediterranean Sea and the Aegean Levantine Seas Sub-regions. Given that the implementation of the methodology for cCI 27 is overall complete during month of July 2020, it can be concluded that these two sub-regions were in non-tolerable status i.e., non-GES during that one month. While it cannot be said much regarding the status during other months, based on the methodological framework elaborated in Section 2), one single month exceeding the 20%, is sufficient to induce non tolerable environmental status, i.e. non GES for continuous noise, for the entire year. The assessment finding for 2020 is therefore non tolerable status, i.e., non GES, for WMS and AEL sub-regions.

672. Figures 5.8.1 and 5.8.2 provide such mapped assessment findings. It is worth noting that tolerable/non tolerable, i.e. GES/non-GES status is indicated by the proportion of affected habitat to see whether the value is above the 20% threshold as specified in the methodology described in Chapter 2. Red areas determine the non-tolerable status of a sub-region but are not to be considered non-GES areas. However, from a management perspective the way red areas are interpreted has little importance as bringing a sub-region below thresholds will induce taking actions to reduce the extent of the red areas, wherever they are found.

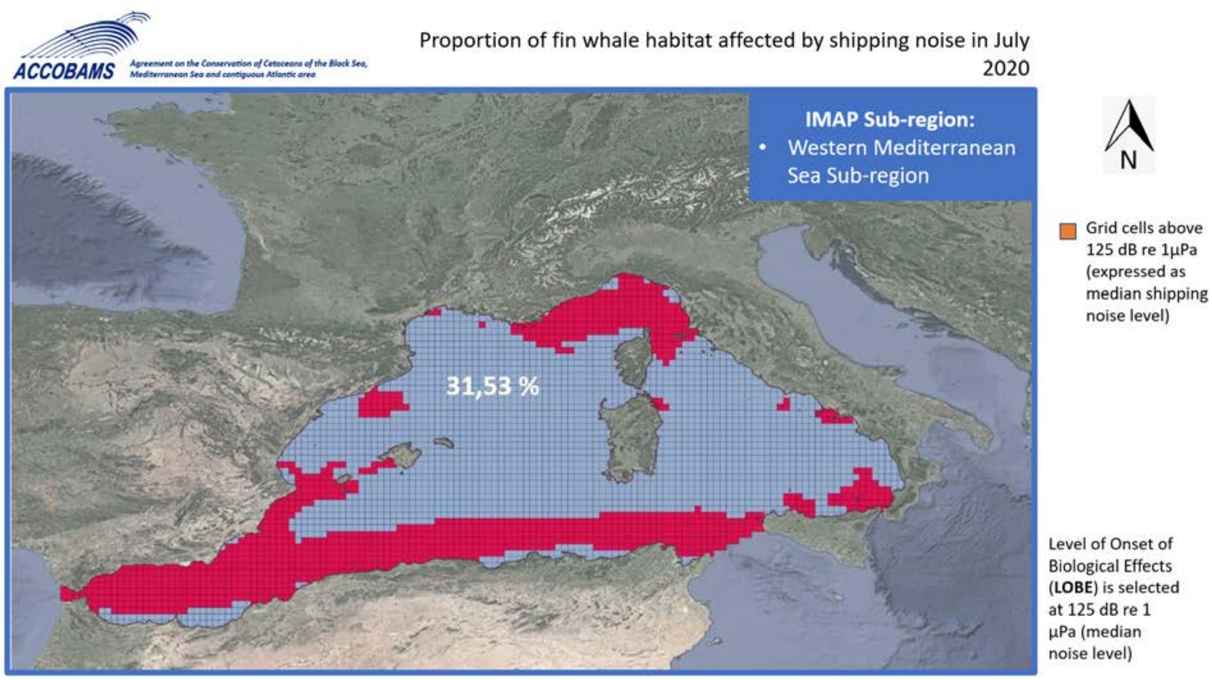

Figure 5.8.1. 3Percent of fin whale habitat (PUHA) exposed to a monthly noise level higher than 125 dB re 1 µPa (LOBE) in the Western Mediterranean Sea Sub-region (WMS). Red cells indicate the area where the Level of Onset of Biological Effects (LOBE, set as median noise level = 125 dB re 1µPa) is exceeded for the month of July 2020.

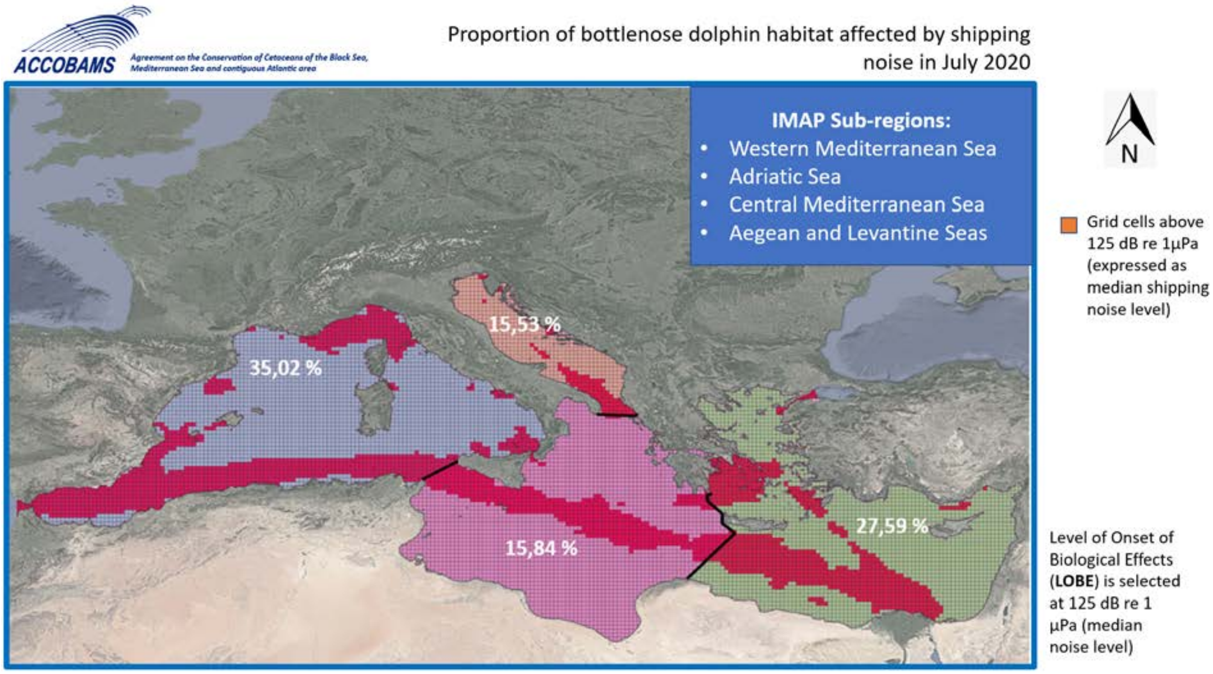

Figure 5.8.2. 4Percent of bottlenose dolphin habitat (PUHA) exposed to a monthly noise level higher than 125 dB re 1 µPa (LOBE) in the Western Mediterranean Sea Sub-region (WMS), Adriatic Sea (ADR), Central Mediterranean (CEN) and Aegean and Levantine Sea (AEL) sub-regions. The picture shows exceedance of thresholds (20% of habitat affected by continuous noise) in the WMS and AEL sub-regions, and compliance in the ADR and CEN sub-regions. Red cells indicate the area where the Level of Onset of Biological Effects (LOBE, set as median noise level = 125 dB re 1µPa) is exceeded for the month of July 2020. Different sub-regions are indicated in different colours.

673. For the Adriatic Sea (ADR) and Central Mediterranean (CEN) sub-regions, the result of the assessment was a tolerable status, i.e. GES for continuous noise, considering that the proportion of habitat of the species considered (bottlenose dolphin) affected by continuous noise was below 20%. As elaborated in Section 2, the Summer months are those with the highest levels of vessel traffic and hence the analysis done on a month of July 2020 can be seen as the worst-case scenario. Based on this, even though quantitative data were not produced for other months, it is possible to conclude that if the month representing the worst case scenario results in tolerable status, i.e. GES for continuous noise, this result can be generalized for the entire year, i.e. the ADR and CEN sub-regions were likely in GES in 2020.

674. Finally, based on these preliminary results, the environmental status of the Mediterranean Sea region is not fully in tolerable status i.e. GES status since the Western Mediterranean Sea and the Aegean Levantine Sea Sub-regions do not comply with the 20% threshold of impacted habitat over the monthly scenario.

6. Measures and actions required to achieve GES[76],[77]

[76] 2023 Med QSR Ecological Objective – Common Indicator structure and outline template UNEP/MED 521/Inf.6: Further to knowledge gaps identified in chapter 5:

- Propose measures and actions to be put in place towards GES achievement (what is the outlook and what are the risks, challenges to look out for)
- Pay particular attention to the steps needed to improve data availability

Note:
Depending on progress in specific GES assessment, this section can be further developed

[77] Upon consideration of the assessment findings as provided in Sections 4 and 5, this chapter will be elaborated.

Annex I (CH 2)

Integration and Aggregation Rules for Monitoring and Assessment of (IMAP Pollution and Marine Litter Cluster

Table I 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/onshore 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 II 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	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		

Ecological objective	**Common Indicator**	**Interrelations with CIs of EO9**	**Monitoring interconnections**
		IMPACT	
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.
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 III 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		
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		

Table IV 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/Onshore areas/waters			Offshore areas/waters		
Pressure related CIs						
	water	sediment	biota	water	sediment	biota
EO5	13+, 14+			13, 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	
EO9	18, 19[*+], 20[+]		18[***], 19[*+], 20[+]	
EO10	24[+]		24[+]	
EO7	15		15[†]	
State related CIs				
EO1	1 Seabed habitats	2, 3, 5 Marine reptiles	1 Seabed habitats	2, 3, 5 Marine reptiles

[*]Depending on the monitoring unit, the accident may happen in either coastal/onshore 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
[***]It is recommended to monitor CI18 (in alternative fish species) in offshore waters
[+]Both pressure and impact CIs
[†] Related to offshore structures

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

		Mediterranean Region			
			Sub-region (i)		
				Sub-division (i)	
				National part	
EOs	**CIs**			**Offshore waters**	**Ccoastal/onshore 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 Beach 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	

Annex II (CH 2)

Reference conditions and boundary values of ecological quality classes for Type I and Type II Adriatic in coastal and open waters

Table I. Reference conditions and boundary values of ecological quality classes expressed by different parameters for Type I in coastal and open waters. Normalized EQRs need to be used in ecological quality assessment.

Boundaries	**TRIX**	***c*(Chl*a*$_{aGM}$)/ µg L^{-1}**	**Chla$_{aGM}$**		***c*(TP$_{aGM}$)/ µg L^{-1}**	**TP**	
			EQR$_{actual}$	**EQR$_{normalized}$**		**EQR$_{actual}$**	**EQR$_{normalized}$**
Coastal waters							
RC		1.40	1.00	1.00	0.19	1.00	1.00
H/G	4.25	2.0	0.70	0.85	0.26	0.73	0.85
G/M	**5.25**	**5.0**	**0.28**	**0.62**	**0.55**	**0.35**	**0.61**
M/P	6.25	12.6	0.11	0.38	1.15	0.17	0.38
P/B	7	25.0	0.06	0.20	2.00	0.10	0.20
Open waters					***c*(DIN$_{aGM}$)/ µg L^{-1}**	**DIN**	
RC		0.29	1.00	1.00	0.66	1.00	1.00
H/G	4.25	1.25	0.23	0.76	5.3	0.12	0.84
G/M	**5.25**	**3.1**	**0.09**	**0.59**	**22.3**	**0.03**	**0.70**
M/P	6.25	7.8	0.04	0.42	93.1	0.01	0.56
P/B	7						
Montenegro							
RC		0.15	1.00	1.00	0.21	1.00	1.00
H/G	4.25	1.25	0.12	0.72	5.3	0.04	0.73
G/M	**5.25**	**3.1**	**0.05**	**0.59**	**22.3**	**0.01**	**0.59**
M/P	6.25	7.8	0.02	0.45	93.1	0.002	0.45
P/B	7						

Table II. Reference conditions and boundary values of ecological quality classes expressed by different parameters for Type II Adriatic in coastal and open waters. Normalized EQRs need to be used in ecological quality assessment.

Boundaries	**TRIX**	***c*(Chl*a*$_{aGM}$)/ µg L^{-1}**	**Chla$_{aGM}$**		***c*(TP$_{aGM}$)/ µg L^{-1}**	**TP**	
			EQR$_{actual}$	**EQR$_{normalized}$**		**EQR$_{actual}$**	**EQR$_{normalized}$**
Coastal waters							
RC		0.33	1.00	1.00	0.16	1.00	1.00
H/G	4	0.64	0.52	0.82	0.26	0.62	0.82
G/M	**5**	**1.5**	**0.22**	**0.61**	**0.48**	**0.33**	**0.61**
M/P	6	3.5	0.09	0.40	0.91	0.18	0.40
P/B	7	8.2	0.04	0.19	1.71	0.09	0.19

Annex III (CH 2)

The assessment criteria and GES assessment categories applied for assessment of IMAP CI 21

Table I. Microbial Water Quality Assessment Category based on Intestinal enterococci (cfu/100 mL) in bathing waters in the Mediterranean (Decision IG.20/9).

Category	**A**	**B**	**C**	**D**
Limit values	<100*	101-200*	185**	>185**[(1)]
Water Quality	Excellent	Good	Sufficient	Poor/Immediate Action

*Based on the 95th percentile; ** Based on the 90th percentile;

- [(1)] For single sample appropriate action is recommended to be carried out once the count for IE exceeds 500 cfu/100 mL:
- For classification purposes at least 12 sample results are needed spread over 3-4 bathing seasons;
- Reference method of analysis: ISO 7899-2 based on membrane filtration technique or any other
- approved technique;
- Transitional period 4 years (starting by 1st January 2012).

Annex IV (CH 3):

The GRID/Table approach and Scoreboards Method/DPSIR Analysis Matrix

Table I : 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 and the related measurement IMAP Common Indicators for EO5 and EO9. Following the analysis presented in this table that is based on the expert judgment, the members of the EcAp Coordination Group can better define/refine specific interactions, for activities contributing to pressures at Common Indicator level.

Pressures vs. measured IMAP Common Indicators (EO5 and EO9)	**Non-Construction Zone**	**Natural Hazards**	**Natural disasters**	**Climate Change**	**Agric. and forestry runoffs**	**Coastal Urbanization**	**Damming (demand on**	**Waste water discharges**	**Industry**	**Tourism frequentation**	**Yachting**	**Marine mining**	**Dredging**	**Desalinization**	**Coastal artificialization.**	**Port operations**	**Offshore structures**	**Cables and pipelines**	**Shipping**	**Oil and gas extraction**	**Renewable energy**	**Fishing (incl. recreational)**	**Sea-based food harvesting**	**Extraction of genetic**	**Aquaculture**	**Solid waste disposal**	**Storage of gases**	**Research and education**	**Defence operations**	**Damping of munitions**
C13. Nutrients																														
C14. Chlorophyll *a*																														
CI17: Key harmful contaminants																														
CI18: Pollution effects																														
CI19: Acute pollution events																														
C20: Contaminants in seafood																														
CI21: Intestinal enterococci																														

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

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

Note: For the purpose of this table onshore and offshore areas are not used as legal terms but as the geographical terms to distinguish different areas with different ecological features for the purpose of monitoring and assessment.

Table III: Template to frame the activities according to the DPSIR approach and links them to the Barcelona Convention measurements system (IMAP). Below template includes agriculture in the inland area as an example, while the complete template that includes all other relevant interrelations is provided in Annex A (Showing an update for the Adriatic Sea Sub-region of the template as presented in UNEP/MED WG.463/Inf.9). The list of activities elaborated in this template is not exhaustive and may be further extended and amended in line with specific circumstances related to concrete examples for which determination of the interrelation between pressure/state/impact is needed. CI, Common Indicator. cCI, Candidate Common indicator

	LANDWARD – INLAND					
Economic (Driver)		**Pressure**	**State**	**Impact (ES)**	**IMAP EOs CIs**	**Regional policy (Response)**
	Activity type				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
Agriculture	Crops (any)	Hydrological alterations	River diversions	Habitat deterioration	(EO8): cCI 25, EO1 (CI 12) EO7 (CI 15)	LBS Protocol Hazardous Substances Protocol SAP/MED Regional Plan on the on the phasing out of lindane and endosulfan, Regional Plan on the Phasing Out of DDT; and other similar Regional Plans for phasing out POPs, EU Biodiversity for 2030, EU Water Framework Directive and the EU Common Agricultural Policy (CAP)
	Crops (any)	Hydrological alterations	River diversions	Loss of biodiversity	EO1, EO8	LBS Protocol Hazardous Substances Protocol SAP/MED Regional Plan on the on the phasing out of lindane and endosulfan, Regional Plan on the Phasing Out

	LANDWARD – INLAND					
Economic (Driver)		**Pressure**	**State**	**Impact (ES)**	**IMAP EOs CIs**	**Regional policy (Response)**
	Activity type				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
						of DDT; and other similar Regional Plans for phasing out POPs, EU Biodiversity for 2030, EU Water Framework Directive and the EU Common Agricultural Policy (CAP)
	Crops (any)	Geomorphological changes	Land alteration	Loss of biodiversity / Population (species) decreases	(EO8): cCI 25, EO1: CI 1	Regional Plan on Marine Litter Action Plan for the management of the Mediterranean Monk Seal Action Plan for the Conservation of Mediterranean Marine Turtle Action Plan for the conservation of cetaceans in the Mediterranean Sea SAP/BIO
	Land crops	Land use	Land degradation	Soil degradation (contaminated, inert)	(EO8): cCI 25	ICZM Protocol
	Wetland crops	Wetlands use	Wetlands degradation	Flooding vulnerability / Clean water provision	(EO8): cCI 25	SPA and Biological Diversity Protocol

Table IV: DPSIR analysis as presented in UNEP/MED WG.463/Inf.9											
	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
1) Agriculture	Crops (any)	Runoff/River (organochlorinated and other chemicals)	Coastal contamination /pollution/ eutrophication	Habitats deterioration; Sea food contamination	BIODIVERSITY (EO1): CI1-CI5; EUTROPHICATION (EO5):CI13-CI14; CONTAMINATION (EO9):CI17, CI18, CI20	Crops (effects seaward)	Runoff/River (organochlorinated and other chemicals)	Coastal and offshore contamination/pollution Eutrophication	Ecosystems deterioration; Sea food contamination	BIODIVERSITY (EO1): CI1-CI5; EUTROPHICATION (EO5):CI13-CI14; CONTAMINATION (EO9):CI17, CI18, CI20	LBS Protocol Hazardous Substances Protocol SAP/MED Regional Plan on the on the phasing out of lindane and endosulfane, Regional Plan on the Phasing Out of DDT; and other similar Regional plans for phasing out POPs

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
	Crops (any)	Runoff (river litter)	Costal litter occurrence (beach, surface and seabed)	Species threaten Natural resources affected Landscape visual impairment	BIODIVERSITY (EO1): CI1-CI5; MARINE LITTER (EO10):CI22, CI23, CI24	Crops (effects seaward)	Runoff (river litter)	Costal litter occurrence (surface, water column, seabed and deep-sea bed)	Long-lived species threaten Natural resources affected Marine ecosystems deterioration	BIODIVERSITY (EO1): CI1-CI5; MARINE LITTER (EO10):CI22, CI23, CI24	Regional Plan on Marine Litter Action Plan for the management of the Mediterranean Monk Seal Action Plan for the Conservation of Mediterranean Marine Turtle Action Plan for the conservation of cetaceans in the Mediterranean Sea SAP/BIO
	Crops (any)	Seaward sediment flux Alterations	Coastal erosion	Coastal surface decrease (beaches, dunes, etc.)	CI16	Crops (effectsseaward)	Seaward sediment flux alterations	Subsidence, unsustained costaline	Loss of coastline	CI16	ICZM Protocol
	Delta crops	Delta use	Delta degradation (contaminated, inert)	Exploited resources affected	CI16	Crops (harvesting)	Coastal micro- and macro algae harvesting	Habitats alterations	Natural resources affected	N/A	SPA and Biological Diversity Protocol

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
2) Industry (land-based sources)	Diverse industrual activities	Industrial wastewater (treated and untreated)	Transitional and coastal water pollution	Chemical and emerging contamination of habitats and species (water column and seafloor)	BIODIVERSITY (EO1): CI1-CI5; CONTAMINATION (EO9):CI17, CI18, CI20	Diverse industruial activities	Diffuse contamination	Coastal and offshore contamination	Pelagic and benthic ecosystem deterioration Seafood contamination	BIODIVERSITY (EO1): CI1-CI5; CONTAMINATION (EO9):CI17, CI18, CI20	LBS Protocol Hazardous Substances Protocol Mercury Regional Plan Offshore Protocol National Baselines Budgets (NBBs) SPA and Biological Diversity Protocol
		Litter increase	Riverine and coastal litter occurrence (surface, beach)	Species threaten Natural resources affected Coastal visual impairment	BIODIVERSITY (EO1): CI1-CI5; MARINE LITTER (EO10):CI22, CI23, CI24		Litter pollution (spread)	Coastal and offshore contamination (surface, water column, seabed, deep-sea bed)	Long-lived species threaten Natural resources affected Marine ecosystems deterioration	BIODIVERSITY (EO1): CI1-CI5; MARINE LITTER (EO10):CI22, CI23, CI24	SPA and Biological Diversity Protocol
		Industrial effluents (occasional inputs, acute events)	Transitional and coastal water pollution	Natural resources loss	CONTAMINATION (EO9): CI17, CI18, CI19, CI20		Sea disposal sites (authorized dumping)	Sea-floor habitats affected (integrity impaired)	Benthic ecosystem loss	SEA-FLOOR INTEGRITY (EO6); CONTAMINATION (EO9): CI17, CI18, CI19, CI20	Dumping Protocol

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
3) Aquaculture	Costal aquaculture (shellfish farming, Fish farming)	Water column and seabed habitats impacted by substances	Eutrophication	Habitats deterioration Bbiodiversity impaired	BIODIVERSITY (EO1): CI1-CI2; EUTROPHICATION (EO5):CI13-CI14; CONTAMINATION (EO9): CI20	Coastal, offshore farming	Pelagic ecosystem impacted by substances	Eutrophication	Habitats deterioration Biodiversity impaired	BIODIVERSITY (EO1): CI1-CI2; EUTROPHICATION (EO5):CI13-CI14; CONTAMINATION (EO9): CI20	SPA and Biological Diversity Protocol
	Coastal aquaculture (shellfish farming, Fish farming)	Marine Litter and Microplastic Generation	Marine Litter and Microplastic generation; lying on the seafloor and float around the Mediterranean	Effect on biota, microplastic ingestion,	MARINE LITTER (EO10) : CI23, CI24						Regional Plan on Marine Litter Management in the Mediterranean SPA and Biological Biodiversity Protocol
4) Fisheries	Fishing vessels (artisanal, trawling, etc.)	Pressures on fish stocks and benthic ecosystems	Marine fisheries decline (over-fishing)	Decrease on fish species of commercial importance	FISHERIES (EO3): CI7-CI12	Fishing vessels (medium power, trawling, etc.)	Pressures on fish stocks and benthic ecosystems	Marine habitats decline	Decrease on fish species of ecological importance	FISHERIES (EO3): CI7-CI12	Regulations and MPAs, SPAs, SPAMIs
	Fishing vessels (artisanal,	Marine Litter and Microplastic Generation,	Marine Litter and Microplastic spread in the water	Effect on marine, biota, ALDFG,	MARINE LITTER (EO10) : CI23, CI24						Regulations and MPAs, SPAs, SPAMIs

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
	trawling, etc.)	"Ghost Fishing"	column and on the seafloor,	Ghost-fishing							
	Extraction of genetic resources	Pressures on fish stocks and benthic ecosystems	Populations diversity impaired	Decrease on fisheries ecological function	BIODIVERSITY (EO1): CI1-CI2	Extraction of genetic resources	Pressures on fish stocks and benthic ecosystems	Populations diversity impaired	Decrease on fisheries ecological function	BIODIVERSITY (EO1): CI1-CI2	SPA and Biological Diversity Protocol
5) Tourism, sporting, recreational activities	Urban/Real-state development	Waste generation (litter, wastewater treatment plants) Urban effluents Microbiological pollution	Degradation of land, air and water sources Occurrence of pathogens	Soil, habitats and coastal forestry loss Bathing water quality detriment	COAST (EO8): CI16; BIODIVERSITY (EO1): CI1-CI2; EUTROPHICATION (EO5): CI13-CI14; CONTAMINATION (CI20-CI21); MARINE LITTER (EO10): CI22, CI23	Urban/Real-state development (only lagoons, islands, etc.)	Waste generation (litter, wastewater treatment plants) Urban effluents Microbiological pollution	Degradation of land, air and water sources Occurrence of pathogens	Soil, habitats and coastal forestry loss Bathing water quality detriment	COAST (EO8): CI16; BIODIVERSITY (EO1): CI1-CI2; EUTROPHICATION (EO5): CI13-CI14; CONTAMINATION (CI20-CI21); MARINE LITTER (EO10): CI22, CI23	LBS Protocol Action Plan for the conservation of marine vegetation in the Mediterranean Sea Action Plan for the conservation of bird species listed in Annex II of the Protocol on Specially Protected Areas and Biological Diversity

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
		Landfills	Contaminated and littered land	Degradation of natural resources Landscape visual impairment	COAST (EO8): CI16		Landfills	Contaminated and littered land	Degradation of natural resources Landscape visual impairment	COAST (EO8): CI16	SPA and Biological Diversity Protocol ICZM Protocol
		Coastal urban expansion	Coastal degradation	Land-sea interface habitat loss and biodiversity loss	COAST (EO8): CI16		Coastal urban expansion	Coastal degradation	Land-sea interface habitat loss and biodiversity loss	COAST (EO8): CI16	ICZM Protocol Land protection regulations (national)
		Increased nutrients	Eutrophication	Habitats deterioration Biodiversity impaired	BIODIVERSITY (EO1): CI1-CI2; EUTROPHICATION (EO5):CI13-CI14		Increased nutrients	Eutrophication	Habitats deterioration Biodiversity impaired	BIODIVERSITY (EO1): CI1-CI2; EUTROPHICATION (EO5):CI13-CI14	SPA and Biological Diversity Protocol
	Scuba-diving activities	Pressures on habitats and functions maintenance (extraction of fish and shellfish)	Sea-floor habitats decline	Alteration on habitats and species of economical ecological importance	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	Scuba-diving activities (only lagoons, islands, etc.)	Pressures on habitats and functions maintenance (extraction of fish and shellfish)	Sea-floor habitats decline	Alteration on habitats and species of economical ecological importance	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	Regulations and MPAs, SPAs, SPAMIs

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
	Fishing vessels (recreation al)	Pressures on fish stocks	Water column habitats (species) decline	Decrease on fish species of ecological and commercial importance	BIODIVERSITY (EO1): CI1-CI2	Fishing vessels (recreational)	Pressures on fish stocks	Water column habitats (species) decline	Decrease on fish species of ecological and commercial importance	BIODIVERSITY (EO1): CI1-CI2	Regulations and MPAs, SPAs, SPAMIs Action Plan for the conservation of cartilaginous fishes (Chondrichthy ans) in the Mediterranea n
	Tourism frequentati on	Pressures on coastline (beaches, natural areas, etc.)	Increased pollution	Coastal areas degradation Habitats alteration Physical loss	BIODIVERSITY (EO1): CI1-CI2; COAST (EO8): CI16	Tourism frequentation (only lagoons, islands, etc.)	Pressures on coastline (beaches, natural areas, etc.)	Increased pollution	Coastal areas degradatio n Habitats alteration	BIODIVERSITY (EO1): CI1-CI2; COAST (EO8): CI16	ICZM Protocol Action Plan for the conservation of marine vegetation in the Mediterranea n Sea Action Plan for the conservation of bird species listed in Annex II of the Protocol on Specially Protected Areas and Biological Diversity

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
	Yachting	Coastal areas navigation, contamination, noise	Increased pollution (biological, chemical, litter)	Coastal areas degradation Habitats alteration	BIODIVERSITY (EO1): CI1-CI2	Yachting	Coastal areas navigation, contamination, noise	Increased pollution (biological, chemical, litter)	Coastal areas degradation Habitats alteration	BIODIVERSITY (EO1): CI1-CI2	SAP/MED SAP/BIO Offshore Protocol
	Tourism facilities	Coastal changes	Land alteration	Loss of biodiversity / Population (species) decreases	BIODIVERSITY (EO1): CI1-CI2; COAST (EO8): CI16	Tourism facilities (only lagoons, islands, etc.)	Coastal changes	Land alteration	Loss of biodiversity / Population (species) decreases	BIODIVERSITY (EO1): CI1-CI2; COAST (EO8): CI16	ICZM Protocol Action Plan for the conservation of marine vegetation in the Mediterranean Sea Action Plan for the conservation of bird species listed in Annex II of the Protocol on Specially Protected Areas and Biological Diversity
	Other small scale activities	Waste generation (litter, waste treatment plants, effluents)	Degradation of coastal environments	Coastal resources integrity impaired Physical loss	BIODIVERSITY (EO1): CI1-CI2; COAST (EO8): CI16	Other small scale activities	Waste generation (litter, waste treatment plants, effluents)	Degradation of coastal environments	Coastal resources integrity impaired	BIODIVERSITY (EO1): CI1-CI2; COAST (EO8): CI16	ICZM Protocol SAP/MED SAP/BIO

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
6) Utilization of specific natural resources	Sea bed mining	Extraction of sea bed substrate	Habitats deterioration	Integrity of sea-floor impaired	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	Sea bed mining	Extraction of sea bed substrate	Habitats and deep-habitats deterioration	Integrity of sea-floor impaired	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	Offshore Protocol Action Plan for Coralligenous and other Calcareous Bio-Concretions
	Desalinization	Uptake of seawater /release of brine and brackish waters	Habitats deterioration	Integrity of sea-floor and water column impaired	N/A	Desalinization	Uptake of seawater /release of brine and brackish waters	Habitats deterioration	Integrity of sea-floor and water column impaired	N/A	LBS Protocol
7) Infrastructure, energy facilities, ports and maritime works and structures	Port/Harbour developments	Land/coastal changes	Degradation of coastal vegetation	Loss of coastal integrity (by erosion)	COAST (EO8): CI16						ICZM Protocol and other UN related conventions
		Waste generation (litter, waste port facilities, effluents)	Coastal fragmentation	Biodiversity (natural) impaired Ecological conectivity loss	BIODIVERSITY (EO1): CI1-CI2 MARINE LITTER (EO10) : CI22, CI23						ICZM Protocol and other UN related conventions LBS Protocol
		Risk of acute pollution events/accidents (hazardous substances, oil)	Water column and seabed habitats decline Biodiversity loss	Natural resources loss Endemic species threatened	CONTAMINATION (EO9): CI17, CI18, CI19, CI20						SPA and Biological Diversity Protocol

Table IV: DPSIR analysis as presented in UNEP/MED WG.463/Inf.9											
	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
		Inputs of nutrients and organic matter enrichment	Loss of endemic species/habitats	Resources loss	EUTROPHICATION (EO5):CI13-CI14						ICZM Protocol and other UN related conventions LBS Protocol
		Microbiologicalpollution	Occurrence of pathogens	Degraded bathing water quality	CONTAMINATION (EO9): CI21						ICZM Protocol and other UN related conventions LBS Protocol
	Port/Marinas developments	Land/coastal change (roads, real-state	Degradation of coastal vegetation	Loss of coastal area integrity (by erosion)	COAST (EO8): CI16						ICZM Protocol and other UN related conventions
		Waste generation (litter, waste port facilities, effluents)	Coasta lfragmentation	Biodiversity (natural) impaired Ecological connectivity loss	BIODIVERSITY (EO1): CI1-CI2; MARINE LITTER (EO10):CI22-CI23						ICZM Protocol and other UN related conventions LBS Protocol
		Risk of acute pollution events/accidents (hazardous substances, oil)	Water column and seabed habitats decline Biodiversity loss	Natural resources loss Endemic species threatened	CONTAMINATION (EO9): CI17, CI18, CI19, CI20						SPA and Biological Diversity Protocol
		Inputs of nutrients and organic matter enrichment	Loss of endemic species/habitats	Resources loss	EUTROPHICATION (EO5):CI13-CI14						ICZM Protocol and other UN related conventions LBS Protocol

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
		Microbiologicalpollution	Occurrence of pathogens	Degraded bathing water quality	CONTAMINATION (EO9): CI21						ICZM Protocol and other UN related conventions LBS Protocol
	Underwater cables and pipelines	Wiring operations disturbance	Habitats decline	Loss of habitats and species	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	Underwater cables	Wiringoperationsdisturbance	Habitats decline	Loss of habitats and species	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	ICZM Protocol and other UN related conventions SPA and Biological Diversity Protocol
	Oil and gas exploration	Exploraiton disturbances (air guns)	Water columna habitats decline	Loss of species, stranding of long-lived species	BIODIVERSITY (EO1): CI1-CI5	Oil and gas exploration	Exploration disturbances (air guns)	Water columna habitats decline	Loss of species, stranding of long-lived species	BIODIVERSITY (EO1): CI1-CI5	ICZM Protocol and other UN related conventions SPA and Biological Diversity Protocol
						Islands, lagoon/ports/marinas	Coastal changes, downward flows interrupted	Degradation of coastalenvironments	Physical loss and habitats loss	COAST (EO8): CI16; BIODIVERSITY (EO1): CI1-CI2	ICZM Protocol and other UN related conventions SPA and Biological Diversity Protocol

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	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
8) Maritime activities	Awaiting-anchoring areas (oil tankers, cargo transport, hazardous substances vessels)	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water columna habitats decline	Healthy coastal water and habitats decline	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	Awaiting areas (oil tankers, cargo transport, hazardous substances vessels)	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water columna habitats decline	Healthy coastal water and habitats decline	BIODIVERSITY (EO1): CI1-CI2; SEA FLOOR INTEGRITY (EO6)	OffshoreProtocol
		Risk of accidents and spills	Water quality degradation	Coastal environment impacted	CINTAMINATION (EO9): CI19		Risk of accidents and spills	Water quality degradation	Coastal and marine environment impacted	CINTAMINATION (EO9): CI19	Offshore Protocol
	Bunkering	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water columna habitats decline	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI19; BIODIVERSITY (EO1):CI1-CI2	Bunkering	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water columna habitats decline	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI19; BIODIVERSITY (EO1):CI1-CI2	Offshore Protocol
		Risk of accidents and spills	Water qualitydegradation		CINTAMINATION (EO9): CI19		Risk of accidents and spills	Water quality degradation		CINTAMINATION (EO9): CI19	Offshore Protocol
	Offshore platforms (oil and gas exploration)	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water columnh abitats decline	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI17, CI18, CI20; BIODIVERSITY (EO1):CI1-CI2	Offshore platforms (oil and gas exploration)	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water columna habitats decline	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI17, CI18, CI20; BIODIVERSITY (EO1):CI1-CI2	Offshore Protocol
		Risk of accidents and spills	Water quality degradation	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI19		Risk of accidents and spills	Water quality degradation		CINTAMINATION (EO9): CI19	

Table IV: DPSIR analysis as presented in UNEP/MED WG.463/Inf.9

	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
	Shipping traffic (commercial, ferries, military, cruise liners)	Introduction of pollutants and noise, litter	Water columna habitats decline	Healthy coastal water and habitats decline	BIODIVERSITY (EO1): CI1-CI2; CONTAMIANTION (EO9): CI17, CI20; MARINE LITTER (EO10): CI22-cC24; ENERGY (EO11): CI26-CI27	Shipping traffic (commercial, ferries, military, cruise liners)	Introduction of pollutants and noise, litter	Water columna habitats decline	Healthy coastal water and habitats decline	BIODIVERSITY (EO1): CI1-CI2; CONTAMIANTION (EO9): CI17, CI20; MARINE LITTER (EO10): CI22-cC24; ENERGY (EO11): CI26-CI27	Offshore Protocol
		Risk of accidents or acute spills	Water qualitydegradation	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI19		Risk of accidents or acute spills	Water quality degradation	Healthy coastal water and habitats decline	CINTAMINATION (EO9): CI19	
		Introduction of NIS (ballast water)	Biodiversity and functions alteration	Healthy coastal water and habitats decline	NON-INDIGENOUS SPECIES (EO2): CI6		Introduction of NIS (ballast water)	Biodiversity and functions alteration	Healthy coastal water and habitats decline	NON-INDIGENOUS SPECIES (EO2): CI6	
	Dredging (natural environment)	Extration of soil substrates	Disturbance of sea-floor integrity impaired	Benthic species and habitats deterioration	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Dredging (natural environment)	Extration of soil substrates	Disturbance of sea-floor integrity impaired	Benthic species and habitats deterioration	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Offshore Protocol
	Offshore energy (renewable)	Occupation of coastal marine space	Surface and pelagic ecosystems altered	Healthy coastal water and habitats decline	BIODIVERSITY (EO1): CI1-CI2	Offshore energy (renewable)	Occupation of coastal marine space	Surface and pelagic ecosystems altered	Healthy coastal water and habitats decline	BIODIVERSITY (EO1): CI1-CI2	Offshore Protocol

Table IV: DPSIR analysis as presented in UNEP/MED WG.463/Inf.9

	COASTAL AREA					SEAWARD - LAGOONS - ISLANDS - OFFSHORE					
(DRIVERS) Economic		**PRESSURES**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**		**PRESSURE**	**STATE**	**IMPACT (Ecosystem Services, Welfare)**	**IMAP EOs and CIs**	**RESPONSES (Regional policy**
	Activity type				**Pressure, Impact and State-based indicators**	**Activity type**				**Pressure, Impact and State-based indicators**	**UN Barcelona Convention**
	Solid waste disposal	Asfixiation of benthic habitats	Habitats and species loss	Healthy coastal benthic habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Solid waste disposal	Asfixiation of benthic habitats	Habitats and species loss	Healthy coastal benthic habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Dumping Protocol
	Storage of gases	Subsubstrates to rage (seismic risks)	Disturbance of sea-floor integrity impaired	Healthy coastal benthic habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Storage of gases	Subsubstrates to rage (seismic risks)	Disturbance of sea-floor integrity impaired	Healthy coastal benthic habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Offshore Protocol
	Defence operations	Noise, contamination and waste material	Coastal and marine environment threatened	Healthy coastal water and habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Defence operations	Noise, contamination and waste material	Coastal and marine environment threatened	Healthy coastal water and habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Offshore Protocol
	Disposal of munition	Dumping of munitions (including bacteriological)	Disturbance of sea-floor integrity impaired	Healthy coastal benthic habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Disposal of munition	Dumping of munitions (including bacteriological)	Disturbance of sea-floor integrity impaired	Healthy coastal benthic habitats decline	SEA FLOOR INTEGRITY (EO6); BIODIVERSITY (EO1): CI1-CI2	Offshore Protocol

SCORECARDS: SEMI QUANTITATIVE APPROACH

Estimate impact 0, 1, 2 or 3

None (0)	Low (1)	Moderate (2)	High (3)

Overall Pressure-Impact (Ecosystem Services) (%):						
	SEAWARD - LAGOONS - ISLANDS - OFFSHORE				**IMPACT SCORE**	
Economic (Driver)		**Pressure**	**State**	**Impact (Ecosystem)**	**Score and % of total impact**	**Regional policy (Response)**
	Activity type					**UN Barcelona Convention**
Maritime activities	Awaiting areas (oil tankers, cargo transport, hazardous substances vessels)	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water column habitats decline	Healthy coastal water and habitats decline	3	Offshore Protocol
		Risk of accidents and spills	Water quality degradation	Coastal and marine environment impacted	3	Offshore Protocol
	Bunkering	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water column habitats decline	Healthy coastal water and habitats decline	3	Offshore Protocol
		Risk of accidents and spills	Water quality degradation		3	Offshore Protocol
	Offshore platforms (oil and gas exploitation)	Introduction of pollutants (oil hydrocarbons and related organic compounds)	Water column habitats decline	Healthy coastal water and habitats decline	2	Offshore Protocol
		Risk of accidents and spills	Water quality degradation		1	IMO
	Shipping traffic (commercial, ferries, military, cruise liners)	Introduction of pollutants and noise, litter	Water column habitats decline	Healthy coastal water and habitats decline	0	Offshore Protocol
		Risk of accidents or acute spills	Water quality degradation	Healthy coastal water and habitats decline	0	IMO
		Introduction of NIS (ballast water)	Biodiversity and functions alteration	Healthy coastal water and habitats decline	3	IMO
	Dredging (natural environments)	Extraction of soil substrates	Disturbance of sea-floor integrity impaired	Benthic species and habitats deterioration	3	Offshore Protocol

Overall Pressure-Impact (Ecosystem Services) (%):						
	SEAWARD - LAGOONS - ISLANDS - OFFSHORE				**IMPACT SCORE**	
Economic (Driver)		**Pressure**	**State**	**Impact (Ecosystem)**	**Score and % of total impact**	**Regional policy (Response)**
	Offshore energy (renewable)	Occupation of coastal marine space	Surface and pelagic ecosystems altered	Healthy coastal water and habitats decline	3	Offshore Protocol
	Storage of gases	Sub substrate storage (seismic risks)	Disturbance of sea-floor integrity impaired	Healthy coastal benthic habitats decline	3	Offshore Protocol
	Disposal of munition	Dumping of munitions (including bacteriological)	Disturbance of sea-floor integrity impaired	Healthy coastal benthic habitats decline	3	Offshore Protocol
				TOTAL SEAWARD IMPACT (Ecosystem services)	**30**	

Figure I. Example of Scoreboard, including semi quantitative assessment and risk-based approach considerations (note: fictional scoring). This tool allows to estimate the magnitude of impacts % of total (of estimated possible) pressures-impacts on the environment and ecosystem services. It also links the Drivers (with detailed forces/activities) with Responses (Action Plans, Protocols, etc. within the Barcelona Convention). The same approach could be used to estimate the item scores (see text).

Annex V (CH 3):

Overall DPSIR analysis for the Adriatic Sea Sub-region countries

Driver 1 Agricultural sector

The size of the agricultural sector in the Adriatic countries is strongly related with the impact in the ecosystem of each identified activity. It appears that the Adriatic economies have a moderate to strong developed primary sector. As per Eurostat's data, the primary sector of Albania represents around 21.6% of the national GDP, followed by Montenegro (9.9%), Croatia (3.9%) and Italy (2.2%) (Table 3.4).

Looking deeper into the available data, it appears that especially in Italy almost 20% of total agricultural land is located in Adriatic regions (i.e., Emilia Romana, Friuli-Venezia Giulia.)[78]. Data for similar analyses for the rest of the non-EU countries do not exist; however, given the size and type of economies it is considered that the majority of the agricultural output is being produced in areas of close geographical proximity to the Adriatic Sea. No data were available for Bosnia Herzegovina.

Besides the impacts existing in the DPSIR matrix, one more Impact was added in the Landward-Inland context, related with the State "river diversions" and use of channels for irrigation. This State appears to exist in several of the Adriatic countries. For example, several of the Albanian rivers are used also for irrigation purposes (i.e., River Aoos). Even though the volumes used for irrigation are not significant, there is a risk of loss of biodiversity especially in periods of droughts or in heavier than usual precipitation. Similar cases are identified in Italy, where several valleys are being irrigated from available water resources. In general, and referring to the whole group of Adriatic countries, the need for irrigation is linked with the development of each primary sector.

Table II. 3.4.1.1 Agriculture sector, % of GDP, Adriatic countries

Country	Agriculture sector, % of GDP
Albania	21.6%
Montenegro	9.9%
Croatia	3.9%
Slovenia	2.3%
Italy	2.2%
Bosnia and Herzegovina	No data

Source: Eurostat, National accounts

The above, in parallel to the climate change threat that leads to extreme weather phenomena (increased precipitation and droughts) can exacerbate the impact of river diversions leading to habitat deterioration (degradation, fragmentation, pollution, disruption of ecosystem processes) and loss of biodiversity. Based on the above, the "loss of biodiversity" impact is added in the matrix. With regards to the impacts scores estimation, it is suggested to keep the scoring of the habitats deterioration at Moderate (2); similar scoring is suggested for the loss of biodiversity since the climate risk in the wider South-South East Europe, where some of the Adriatic countries belong, is considered significant. Furthermore, the increase of average temperature is expected to increase the demand for irrigation in the primary sector contributing to, at least, the moderate scoring.

The Response towards the above Pressures and States are already addressed by all the relevant protocols of the Barcelona conventions, therefore no changes are suggested in that sense. However, relevant EU policies such as the EU Water Framework Directive, the EU Biodiversity strategy for 2030, the EU Habitats directive and the Common Agricultural Policy (CAP) are added; these are applicable for the EU

[78] Source: I.stat, Agriculture data, Economic output and structure of agricultural holdings

member states of the Adriatic region (Italy, Slovenia and Croatia) but could be also relevant for Albania and Montenegro (EU accession countries).

Loss of biodiversity in these specific ecosystems is related with Ecological objectives 1 (Biological diversity) and 8 (Coastal ecosystems and landscapes).

Similar to the issues mentioned above, agriculture and the river alterations do also affect the natural habitats in several ways. Infrastructure development (such as dams and dikes), use of water channels for irrigation (or pipes) are among the core causes of habitats' deterioration and of relevant ecosystem services. This affects not only landward-inward ecosystems but coastal areas and aquatic ecosystems. Again, the magnitude of this indicator is related to the size of the agricultural sector in the Adriatic countries. Climate change is expected to accelerate habitats' deterioration as temperature increase (and all linked extreme weather events) affects ecosystems and species directly. Due to the above and given that the Adriatic countries are located in a zone highly impacted by climate change, it is suggested that the impact scoring is increased from Moderate (2) to High (3) for the Landward-Inland.

With regards to the coastal area, the coastal contamination (and eutrophication) from the use of chemical fertilisers and/or pesticides used in the wider agriculture sector is also affecting habitats. Modern farming practices, such as organic farming, require less or no chemical fertilisers, reducing habitats' deterioration in both landward (application sites) and coastal areas. The level of organic farming for the Adriatic countries is assessed only for the EU Member States (since these countries publish relevant data). Specifically, based on Eurostat data for 2020, 16.0% of the used agricultural area in Italy is under organic farming, while in Slovenia and Croatia organic farming practices are applied in 10.3% and 7.2% of the agricultural area, respectively. Interestingly enough, the relevant rates show some positive trends in these countries. On the other hand, data and information scarcity on the diffusion of organic practices in the non-EU countries of the Adriatic region, together with some signs of poor implementation of the national environmental laws do not allow for a confident assessment of the progress noted in organic farming in these economies. Based on the above and on the potentially asymmetric performance between EU/Non-EU Adriatic countries, it is suggested the score for the landward-inward ecosystem remains Moderate (2) and for the coastal area Low (1).

The policies mentioned already in the DPSIR analysis (Responses column) cover all the relevant protocols by the Barcelona Convention. An addition could include EU policies that are being adopted in the EU Member States; these could potentially also affect EU accession countries in the next period. Indicative European policies relevant to this activity (and the Driver in general) include EU Biodiversity for 2030, EU Water Framework Directive and the EU Common Agricultural Policy (CAP).

Habitats' deterioration is mentioned to be related with EO8 and CI25 (Land use change). In addition to that, it can be related to EO1 (CI2) and to EO7 (CI15 Location and extent of the habitats impacted directly by hydrographic alterations (EO7) to also feed the assessment of EO1 on habitat extent).

The provided DPSIR analysis identifies soil degradation caused by the agricultural sector as High (3) in the Adriatic regions. This can be justified by both the size of the agriculture sector, which is significant in all countries, but also from the fact that the use of farming practices of lower environmental impact (i.e., organic farming), which are usually more expensive, are less frequent in non-EU countries. For example, the very low average income of farmers (in Albania it is just above the threshold of poverty)79 does not allow the use of expensive resources that could increase productivity or for practices that support soil

[79] Guri F, Kapaj I, Musabelliu B, Meço M, Topulli E, Remzi K, Hodaj N, Domi S, Mehmeti G, Gomez Y Paloma S. Characteristics of farming systems in Albania, Joint Research Center, 2015

recovery. Therefore, the High (3) impact provided is justified and no changes are suggested. Similar to the biodiversity loss described above, soil degradation is related with EO8 and candidate CI25.

Driver 2 Industry (land-based sources)

The level and the type of industrial production defines the impact of this driver to the wider natural and anthropogenic ecosystems of the Adriatic countries. The Industrial sector differs significantly among the Adriatic countries and so is the level of efficiency in the several production processes noted. This hinders the horizontal assessment of the effect to the local ecosystems. Therefore, in the section below which is related to industrial activities, the provided assessment is based mostly on qualitative characteristics of each Adriatic country's industry (i.e., type of process and type of fuel inputs used). Table 3.5 below contains an overview of the main manufacturing sectors and the dependence on natural resources of each country. In some cases, the type of dependence, together with the fact that most of the required inputs are extracted domestically and not imported (especially relevant to poorer economies) also signifies the impact to specific ecosystems (timber: deforestation, aluminium bauxite: mining processes and use of chemicals).

Table II. 3.4.1.2 Main manufacturing sectors and dependence on natural resources, Adriatic countries

Adriatic country	Main manufacturing sectors	Dependence on natural resources
Albania	Lumber, oil, chemicals, mining, basic metals	Cement
Bosnia and Herzegovina	Mining (Steel, coal, lead, zinc, bauxite, cement), textiles, oil refining	Aluminium Bauxite, Lignite, Cement, Timber
Croatia	Chemicals and plastics, metal, iron, steel, aluminium, textiles, ship-building, Tourism	Aluminium bauxite, Cement, Timber, Crude oil and natural gas
Italy	Electronics, steel, ceramics, pharmaceuticals.	Cement, crude oil and natural gas
Montenegro	Steel, aluminium, agricultural processing	Aluminium Bauxite, Lignite, Timber,
Slovenia	Electrical and electronics, metal processing, Mining	Aluminium bauxite, lignite, timber

Source: [80]

As it is noted above, the Industry of several Adriatic countries relies on mining processes and extraction of relevant natural resources (such as metals and timber). Mining activity has a significant environmental impact since the extraction of resources leads to changes in the landscape. Other manufacturing processes, such as those of plastics and chemicals require large areas where the production units are installed and operated.

Based on the above, land occupation and loss of land appears to be a possible State impacting the habitats characteristics, especially in those countries where mining and activities of similar impact is intense. However, based on the different size of the Industry in each country, it is suggested the reduction of scoring for this Impact to Moderate (2) from the current scoring of High (3). The intensification of the

[80] Research for Regi committee Adriatic and Ionian region: Socio-economic analysis and assessment of transport and energy links, 2015, European Parliament

Industrial processes in countries which are currently prone to investments due to lower labour and other costs (and perhaps less strict legal frameworks) might lead to the increase of the score in the future.

The above are relevant with the EO8 (CI25).

Waste management in the Adriatic, and in the Southern part of Europe, is generally not effective. Most of the Adriatic countries are characterised by low circularity, due to inefficient waste management techniques (disposal into land in landfills or dumpsites). On the other hand, the EU member states (Italy and Slovenia) have more advanced waste management systems. Slovenia implements recycling and waste to energy systems significantly reducing the amounts of waste landfilled (8.5% in 2020 based on Eurostat data).

Table II. 3.4.1.3 An overview of waste management systems and performances in the Adriatic countries

Adriatic country	Waste management
Albania	Most of generated waste are disposed in landfills and dumpsites.
Bosnia and Herzegovina	Mostly landfills – only 6 are following EU criteria. More are designed
Croatia	65% landfilling, 30% recycling, 5% composting, no waste to energy
Montenegro	94.5% landfilling, 5.0 % recycling, composting less than 5%
Italy	22.1% landfilling, 21.3% waste to energy and incineration, 30.4% recycling, 26.1% composting
Slovenia	8.5% landfilling, 56.8% recycling, 16.6% waste to energy and incineration, 18.1% composting

Sources: For non-EU countries data

Based on the above and mainly on the fact that in the non-EU countries of the Adriatic region there are several sources according to which that the generated waste is disposed into land without any sort of treatment (i.e., dumpsites), it is rational to conclude that the impact to the ecosystem with regards to habitats loss and biodiversity is intense. The High (3) scoring in the land ecosystem is confirmed.

Riverine littering and pollution, also driven by Industrial processes, impact the quality of water and affect biodiversity, natural resources and lead to the deterioration of the marine ecosystems. Similar to the previous assessment, the High (3) scoring in the effects of concentration of litter in the coastal ecosystems is confirmed.

With regards to the land ecosystem, the above impact is related with EO9 (Pollution) and the CI18, CI19, C20. Relevance with the CI21 based on the chemical composition of litter discharged. In addition, it is related with EO1 (Biodiversity) and CI1 and CI2.

Industrial effluents, if not properly treated become a major contamination source. In Bosnia Herzegovina, the inadequate disposal of industrial wastewater has been highlighted as a key environmental problem attributed to lack of water strategies and limited financial resources for investments in treatment facilities. A similar situation has been reported in the past for Albania and Montenegro, with large volumes of industrial wastewater being discharged in surface water bodies[81]. In contrast, in the EU member states (Italy, Slovenia) the implementation of the relevant directives and a more effective monitoring of the European and national legislation together with the availability of different type of EU and national funds led to the treatment of industrial wastewater generated. Based on the above and on the significance of disposing untreated industrial effluents to water bodies for the biodiversity and human health, the scoring provided in the analysis of High impact (3) is confirmed.

In addition, the disposal of industrial wastewater generates coastal pollution affecting marine flora and fauna. The situation described in the previous paragraphs, which affects most of the Adriatic countries, leads to similar conclusions for the impact to marine habitats and species as well as in the islands (deterioration of pelagic and benthic ecosystem, seafood contamination - High impact).

With regards to the relevant ecological objectives in the land ecosystem, the above impact is related to EO9 (CIs17-21 depending on the type of effluents). In the coastal ecosystem, besides the EO9, a relevance is added also with EO1 (CI1 and CI2) due to the change in the properties of the ecosystems and the natural resources loss. Finally, for the islands, the selection of EO6 (sea floor integrity – no indicator assigned yet) and EO9 (CIs17-21, as above) is confirmed.

The responses to the above activities and pressures are related with the type of effluents/waste produced. The relevant protocols and plans of the Barcelona convention include the Land-based sources protocol, the Hazardous Substances Protocol, the Mercury Regional Plan, the Offshore Protocol, SPA and Biological Diversity Protocol. Furthermore, for the EU member states (and perhaps also the candidate countries) the following European directives are relevant: EU Coastal and Marine policy (related to marine litter), the EU Waste Framework directive (with the relevant updates), the REACH regulation, and the Water Framework directive. The European Industrial sector is also driven by the EU Industrial Strategy which is also related to environmental sustainability elements.

Driver 2 Aquaculture

The size of the aquaculture sector and its socioeconomic impact varies significantly among the Adriatic countries. In Albania, aquaculture contributed more than 50% to the total annual national production of fisheries in 2020[82]. In Croatia, the share of aquaculture in the total fishery production exceeded 21% (2021 data), which is higher than the EU average of 20.4%. Farming of aquatic organisms in Croatia includes marine and freshwater aquaculture. With 85% of production, marine aquaculture has the largest share in the total aquaculture production in 2021[83].

Bosnia Herzegovina has a long tradition in aquaculture. The sector covered the vast majority of the national production (above 90%) up to 2010 (no data found since). As per relevant reports, the sector has a great potential for increasing the production further, due to the rich natural resources[84]. In Montenegro, production of aquaculture is stable over the years at around 2,000 metric tons per year. Finally, Italy has the largest production among the Adriatic countries (122,000 metric tons in 2020).

Based on consolidated data referring to the total production from the sector among the Adriatic countries, it appears that during the 2017-2020 period, the production was increased in Albania and Croatia, reduced in Italy and remained relatively stable among the rest of the Adriatic countries. The socio-economic importance of aquaculture for those countries is significant, so is the effect to the natural ecosystems. The

[81] World Bank Group, Country water notes. Data retrieved for Albania, Montenegro, and Bosnia and Herzegovina. However, these data refer to a period between 2005-2010 – more recent credible sources were not tracked.
[82] Eurofish international organisation, data for Albania. Available at: https://eurofish.dk/member-countries/albania/
[83] https://www.fao.org/fishery/countrysector/naso_croatia
[84] FAO, Country brief. Available at: https://www.fao.org/fishery/en/facp/bih

increase of aquaculture activity is followed by changes in land (land alteration), which impacts habitats and biodiversity (land ecosystem). Similar impact is noted in the coastal and island ecosystems from the additional use of resources necessary for the aquaculture (i.e., fishfeed, fishoils and chemicals). The additional use of these substances increases eutrophication in both coastal and marine ecosystems. By using the above data, the High effect (3) noted in the habitats deterioration and changes in biodiversity caused in all three ecosystems is confirmed. These are related with EO8 (CI25), with EO1 (CI1, CI2, CI5), EO5 (CI13) and EO9 (CI20). A relevant addition of EO1 is carried out in all ecosystems in the DPSIR matrix.

Annex VI (CH 3):

Summary of DPSIR findings based in previously adopted UNEP/MAP document

Drivers and Pressures

Demographic trends- Driver
Population increase: The population continues to grow in coastal and urban areas of the Mediterranean region, with a younger population in the Southern and Eastern Mediterranean countries (SEMCs) as compared to Northern Mediterranean Countries (NMCs). Around 70% of the Mediterranean population lives in urban areas, while one out of three people live in a Mediterranean coastal region. Moreover, the Mediterranean region is a global hotspot for migration, that further increase the population. However, Mediterranean sub-regions present different demographic dynamics: the MED EU countries have seen their populations stabilize since the 1980s, whereas the eastern (MED Balkans and Türkiye) and southern populations (MED South) have more than doubled from roughly 162 million people in 1980 to 336 million in region 2019 (UN DESA, 2019).
Changing lifestyle and consumption pattern. Improvement in socio-economic status is changing lifestyle and consumption patterns. The is facing an overall acceleration pressure of linear production and consumption patterns, generating more waste instead of a circular model of reuse and recycling. A significant gap persists between MED EU and MED South and MED Balkans and Türkiye countries in terms of economical performances with the three subregions being affected differently by global and local changes

Human activities- Driver
Tourism, Coastal, Maritime and Cruising destinations. The intensification of urbanization in coastal areas is further exacerbated by the growing number of tourists visiting the Mediterranean, which remains the largest global tourism destination to date (UNEP/MAP-Plan Bleu, 2020). Tourism increases economic growth but is also recognized as resource-intensive, demanding high energy and water resources and promoting environmental degradation, such as poor bathing water quality or littered beaches if not properly managed. Tourism has a high spatial and temporal variation : it is predominantly concentrated along the coast during the summer season.
Maritime transport, shipping lanes. Pressures from maritime transport include emissions of air pollutants(gases and particulates like sulphur oxides (SOx) and nitrogen oxides (NOx), which are toxic for humans, and green house gases) with particularly high pressures on port cities; potential accidental and illicit discharges of oil and contaminants; marine litter; water discharge, including ballast water, and hull fouling; underwater noise and its impact on cetaceans; collisions with marine mammals; land take through port infrastructure; and anchoring (destructive for seafloor ecosystems).
Use of the coast and the offshore coastal zone for : Gas and oil drilling and offshore platforms, desalination, fisheries and aquaculture (mariculture), agriculture, industry. Pressures from these sources include marine discharge of wastes (treated and non-treated) that may contain nutrients, chemical and pollutants, fertilizers and pesticides; introduction of marine litter, oil pollution, introduction of non-native species; cause habitat change and loss, among others.

Climate change- Driver
The Mediterranean basin is affected by climate change at a pace well above the global average, in particular by more rapid warming of the ambient air and sea surface in all seasons. In parallel, the sea surface temperature in the Mediterranean already warmed by around 0.4°C per decade during the period between 1985 and 2006, and is expected to reach between + 1.8°C and + 3.5°C by 2100. The sea is absorbing CO_2, which causes ocean acidification at an unprecedented rate of - 0.018 to - 0.028 pH units per decade in the surface waters of the North-Western Mediterranean, with significant consequences expected on calcifying organisms, impacting marine biodiversity and aquaculture Climate change already exacerbates regional challenges, inducing an increase in risks of droughts, floods, erosion, and fires and extreme events. In the upcoming decades, climate change is expected to further threaten food and water security, as well as human livelihoods and health. Tourism, fisheries, aquaculture and agriculture have already started to be adversely affected by changes in general climatic patterns and extreme events. The

quality and quantity of freshwater resources are decreasing, while warming and decreased precipitation locally are leading to the reduction of yields (especially for winter and spring crops in the South) and increased irrigation requirements.

State and Impact

Changes in coastal land cover and use
Land cover and land use in the Mediterranean region continue to change as a result of human activities, with urban sprawl (expansion of residential, tourist, commercial and industrial areas) and infrastructures spreading throughout the region. In the coastal belt, the built-up area has increased substantially in the last decades. Between 1975 and 2015, three out of four Mediterranean countries doubled or more than doubled the built-up area in the belt situated within 1 km of the coastline.
The past and ongoing coastal development cause a decrease in rocky shores and cliffs, loss of coastal wetlands and of sandy shores. Loss of habitats results in loss of services such as water purification, flood and drought mitigation, as provided by wetlands; loss of natural sea defenses, nutrient cycling and erosion control, as provided by rocky and sandy shores, among others. Land-use change and subsequent coastal fragmentation represent a major driver of the loss of biodiversity and ecosystem services in the Mediterranean basin to date.

Introduction of alien species and changes in diversity
The Mediterranean Sea, particularly the Levantine basin, are hotspots for the introduction of alien species, some of which are causing a decrease or collapse in native species populations. Drivers: shipping (by means of ballast water and hull fouling), corridors, maritime transport and waterways, aquaculture, trade in living marine organisms (aquarium trade and fishing bait) and others (e.g. fishing activities and aquarium exhibits). Moreover, habitat loss and overfishing are changing the diversity as well as increasing the risk of fish species in the Mediterranean. Climate change and warming of the Mediterranean Sea has led to the spread of some “warm-water” invaders and the reduction of some indigenous species. Ocean acidification may lead to further decrease in diversity and loss of shell forming animals.

Introduction of contaminants
Nutrients, heavy metals, Persistent Organic Pollutants (POPs), pesticides, hydrocarbons, and marine litter are the main pollutants of the Mediterranean Sea and efforts have so far not succeeded in achieving GES of the waters in many places. Levels of major pollutants show a decreasing trend, even though important issues remain, especially for heavy metals in coastal sediments, as well as in known hotspots associated with urban and industrial coastal areas.
Eutrophication represents a major issue in coastal areas influenced by natural and anthropogenic inputs of nutrients, such as the Gulfs of Lion and Gabès, the Adriatic Sea, the Northern Aegean, and the Nile-Levantine. The exploration and exploitation of recently-discovered large offshore gas fields have increased environmental, health and safety risks, in particular in the Levantine basin.
The Mediterranean is one of the areas in the world most highly affected by marine litter (in particular microplastics) due to an increase in plastic use, the lack of recycling, unsustainable consumption patterns, inadequate and ineffective waste management, high pressures from tourism and shipping, coupled with significant riverine inputs. Marine litter impacts marine organisms mainly through entanglement and ingestion, but also through colonization and rafting. It also creates an economic burden through clean-up costs, and the potential loss of income and jobs from tourism, residential property values, recreational activities and fisheries. The effects of micro- and nanoplastics and associated POPs and Endocrine Disrupting Chemicals (EDCs) in the marine environment represent an additional risk to human health and marine organisms.
Health sector influences the state of the environment, producing a magnitude of different kinds of waste, including untreated pharmaceutical residues in wastewater that travel down water basins and end up in the marine environment, and potentially in the food chain. Liquid waste from healthcare facilities can contain

radioactive elements, heavy metals and hazardous substances from laboratories, bacteria and pathogens, blood, etc. leading to environmental contamination and health hazards, if not properly and fully disposed of via specific processes. If discharged directly into municipal wastewater networks, liquid medical waste is likely to remain untreated because municipal wastewater treatment facilities are not geared to treat such waste. The COVID 19 pandemic increased drastically the use and disposal of gloves, masks, syringes, and disinfectants.

Annex VII (CH 3)

Additional sources describing DPSIR

GEF Project (*Global Environment Facility):* Adriatic Implementation of the Ecosystem Approach in the Adriatic Sea through Marine Spatial Planning

Albania. Driver/Pressure. About 15% of the coastline is urbanized inducing nutrient enrichment and pollution. Tourism is increasing sharply increasing marine litter, among others. Between 15-40% of disposed plastic waste reaches the sea. Status The initial assessment of pollution (EO9) shows established significant concentrations of mercury and organochlorinated compounds in some of the assessed areas on the northern and central coast of Albania, as well as in Vlora Bay, in the southern part. Concentrations in seawater indicate persistent inputs of contaminants from nearby agricultural and urbanised areas and ports. In the Bay of Durrës Porto Romano is an area of rising concern, as these preliminary screening datasets indicate high toxicological levels in sediment samples of PCBs and pesticides. On the other hand, GES has been achieved regarding the occurrence, origin and extent of acute pollution events, and for intestinal enterococci concentration measurements within established standards.

Montenegro. Driver/Pressure. Some significant signs of pressures regarding contaminants (EO9) and marine litter (EO10) were found. About 32.5% of the coastline is urbanized, while tourism consists mainly beach goers. Nearshore activities, such as shipyards and ports are also of concern. The key threats identified were unsustainable tourism, overfishing, and pollution by untreated sewage and agricultural run-off and marine litter. Status. The preliminary assessment of pollution (EO9) shows higher concentration of contaminants in the coastal area, particularly in Boka Kotorska Bay. The levels of some contaminants exceed the established limit, specifically legacy pollutants such as heavy metals and organohalogen compounds: mercury contained in sediments in the open coastal areas of Budva and Bar, and cadmium and lead around Bar. Significant amounts of floating and seabed litter have also been observed. Based on the available data, coastal areas seem to be under the greatest pressure, with particular concern to the area of Boka Kotorska Bay.

Baltic Sea Assessment[85]

In the holistic assessment of the state of the Baltic Sea it was stated that "human activities in the sea and its surroundings are responsible for pressures on the environment. The size of the catchment area of the Baltic Sea is four times the size of its surface area and is currently inhabited by around 85 million people. Inputs from human activities in the catchment area, such as nutrient loading and hazardous substances, add to pressures from human activities at sea, causing cumulative impacts to the status of the marine environment". Important current pressures acting on the Baltic Sea environment are shown in Figure IV 3.3.1, together with links to the many human activities that may contribute to them. These activities and pressures are relevant for the Mediterranean as well.

[85] http://stateofthebalticsea.helcom.fi/humans-and-the-ecosystem/activities-pressures-and-welfare-impacts/

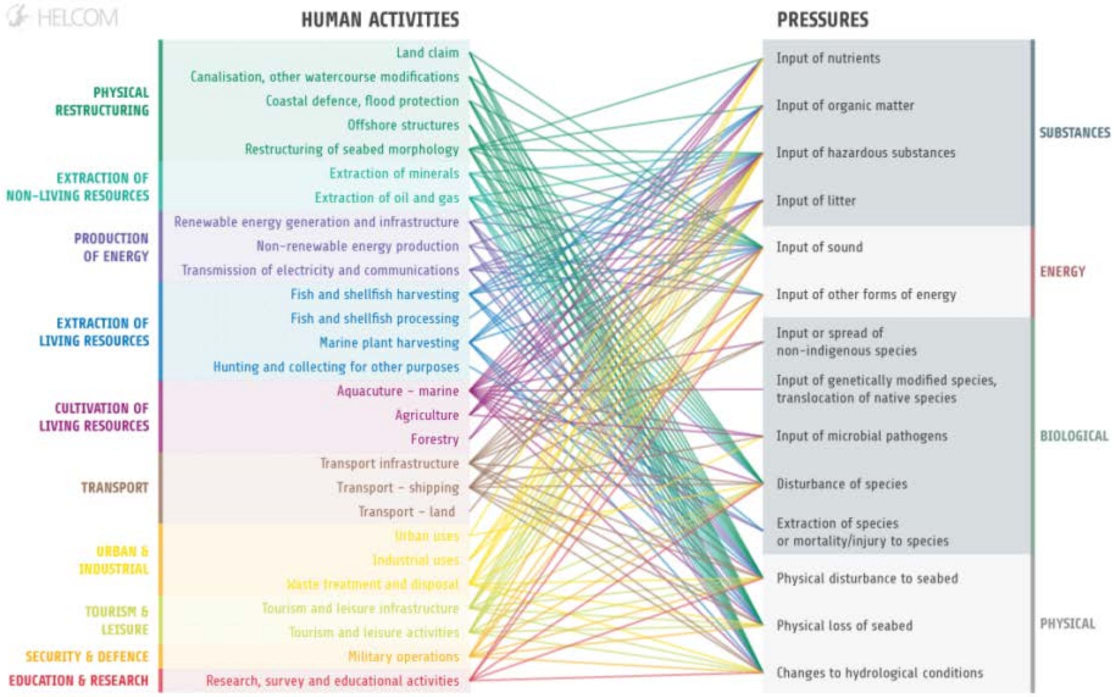

Figure IV 3.3.1. Human activities in the Baltic Sea and their connection to pressure types**.** The lines show which pressures are potentially connected to a certain human activity, without inferring the pressure intensity nor potential impacts in each case. The figure illustrates the level of complexity involved in the management of environmental pressures

Annex VIII (CH 4.3.2):

The spatial assessment units (SAUs) along with the spatial and temporal coverage of monitoring data collected for the Adriatic Sea Sub-region

Table I. The spatial assessment units (SAUs) for the Adriatic Sea Sub-region and their respective surface area (km^2) and number of monitoring stations located in the SAUs.

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP sub SAU	Area (km^2)	Total No stations	stations/ area
North Adriatic (NAS)				**31856**	**84**	**0.003**
	NAS coastal			**9069**		
		MAD-HR-MRU_3		6422	19	0.003
			HRO3-0313-JVE	73	1	0.014
			HRO-O313-BAZ	4	1	0.259
			HRO-O412-PULP	7	1	0.149
			HRO-O412-ZOI	473	3	0.006
			HRO-O413-LIK	7	1	0.150
			HRO-O413-PAG	30	1	0.033
			HRO-O413-RAZ	10	1	0.097
			HRO-O422-KVV	494	2	0.004
			HRO-O422-SJI	1923	2	0.001
			HRO-O423-KVA	686	1	0.001
			HRO-O423-KVJ	1089	1	0.001
			HRO-O423-KVS	577	1	0.002
			HRO-O423-RILP	6	1	0.178
			HRO-O423-RIZ	475	1	0.002
			HRO-O423-VIK	455	1	0.002
		IT-NAS-C		2592	27	0.010
			Emilia Romagna	371	6	0.016
			Friuli Venezia Giulia	575	4	0.007
			Veneto	1646	17	0.010
		MAD_SI_MRU_11		55	7	0.127
	NAS offshore			**22788**		
		IT-NAS-O		10540	23	0.002

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP sub SAU	Area (km^2)	Total No stations	stations/ area
		MAD_SI_MRU_12		129	8	0.062
Central Adriatic (CAS)				**63696**	**60**	**0.001**
	CAS coastal			**9394**		
		MAD-HR-MRU-2		7302	14	0.002
			HRO-0313-NEK	253	1	0.004
			HRO-O313-KASP	44	2	0.045
			HRO-O313-KZ	34	1	0.029
			HRO-O313-MMZ	55	1	0.018
			HRO-O413-PZK	196	2	0.010
			HRO-O413-STLP	1	1	1.580
			HRO-O423-BSK	613	2	0.003
			HRO-O423-KOR	1564	3	0.002
			HRO-O423-MOP	2480	1	0.000
		IT-CAS-C		2092	20	0.010
			Abruzzo	282	8	0.028
			Marche	319	8	0.025
			Molise	229	2	0.009
	CAS offshore			**54303**		
		IT-CAS-O		22393	25	0.001
		MAD-HR-MRU_4		18963	1	0.000
South Adriatic (SAS)				**44231**	**78**	**0.002**
	SAS coastal			**7276**		
		MAD-HR-MRU_2		4252	3	0.001
			HRO313-ZUC	13	1	0.078
			HRO423-MOP	1756	2	0.001
		IT-SAS-C	(Apulia)	1810	8	0.004
		MNE-1		483	45	0.093

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP sub SAU	Area (km^2)	Total No stations	stations/ area
			MNE-1-N	86	5	0.098
			MNE-1-C	246	12	0.049
			MNE-1-S	151	7	0.046
			MNE-Kotor	85	21	0.247
		AL-C		646	4	0.006
	SAS offshore			**36955**		
		IT-SAS-O		22715	5	0.000
		MNE-O		2076	14	0.007
			MNE-12-N	513	4	0.008
			MNE-12-C	713	4	0.006
			MNE-12-S	849	7	0.008
		AL-O		716	2	0.003
		MAD-EL-MS-AD		2253	1	0.0004

Table II: Spatial coverage of monitoring data collected for the Adriatic Sea. The number /of monitoring stations in the IMAP SAUs of the Adriatic Sea per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) is shown.

Sub-division	**Zone**	**SAU**	**sub SAU**	**No stations sediment**			**No stations biota**		
				TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
North Adriatic (NAS)				**71**	**45**	**23**	**31**	**14**	**19**
	NAS coastal/								
		MAD-HR-MRU-3		**19**	**-**		**11**		**11**
			HRO3-0313-JVE	1			1		1
			HRO-O313-BAZ	1					
			HRO-O412-PULP	1					
			HRO-O412-ZOI	3			1		1
			HRO-O413-LIK	1			1		1
			HRO-O413-PAG	1			1		1
			HRO-O413-RAZ	1					
			HRO-O422-KVV	2			1		1
			HRO-O422-SJI	2			1		1
			HRO-O423-KVA	1			1		1
			HRO-O423-KVJ	1			1		1
			HRO-O423-KVS	1			1		1
			HRO-O423-RILP	1					
			HRO-O423-RIZ	1			1		1
			HRO-O423-VIK	1			1		1
		IT-NAS-C		**19**	**23**	**13**	**8**	**8**	**8**
			Emilia Romagna	6	16	6			
			Friuli Venezia Giulia	4					
			Veneto	9	7	7	8	8	8
		MAD_SI_MRU_11		**8**	**9**		**9**	**5**	

Sub-division	**Zone**	**SAU**	**sub SAU**	**No stations sediment**			**No stations biota**		
				TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
	NAS offshore								
		IT-NAS-O		**23**	**12**	**10**	**2**		
		MAD_SI_MRU_12		**3**	**1**		**1**	1	
Central Adriatic (CAS)				**58**	**23**		**12**		**6**
	CAS coastal								
		MAD-HR-MRU-2		**14**			**6**		**6**
			HRO-0313-NEK	1			1		1
			HRO-O313-KASP	2			1		1
			HRO-O313-KZ	1					
			HRO-O313-MMZ	1			1		1
			HRO-O413-PZK	2			1		1
			HRO-O413-STLP	1					
			HRO-O423-BSK	2			1		1
			HRO-O423-KOR	3			1		1
			HRO-O423-MOP	1					
		IT-CAS-C		**18**	**8**				
			Abruzzo	8	8				
			Marche	8					
			Molise	2					
	CAS offshore								
		IT-CAS-O		25	**7**		**6**		
		MAD-HR-MRU_4		1					
South Adriatic (SAS)				**78**	**52**	**45**	**22**	**14**	**15**

Sub-division	Zone	SAU	sub SAU	No stations sediment			No stations biota		
				TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
	SAS coastal								
		MAD-HR-MRU_2		**3**			**5**		**2**
			HRO313-ZUC	1			1		1
			HRO423-MOP	2			2		1
		IT-SAS-C	**(Apulia)**	**8**			**2**		
		MNE-1		**46**	**41**	**34**	**15**	**12**	**11**
			MNE-1-N	5	5	3			
			MNE-1-C	12	12	11	2	2	2
			MNE-1-S	8	8	6	1	1	1
			MNE-Kotor	21	16	14	12	9	8
		AL-C		**4**					
	SAS offshore								
		IT-SAS-O		**5**					
		MNE-12		**12**	**11**	**11**	**2**	**2**	**2**
			MNE-12-N	3	2	2	1	1	1
			MNE-12-C	4	4	4			
			MNE-12-S	6	5	5	1	1	1
		AL-O		**2**					
		MAD-EL-MS-AD		**1**	**1**				

Table III: Temporal coverage of the monitoring data collected for the Adriatic Sea. The years of data collected per SAU and per contaminant group (trace metals (TM), PAHs, PCBs) are shown.

Sub-division	Zone	SAU	Years monitored Sediments			Years monitored biota		
			TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
North Adriatic (NAS)								
	NAS coastal/intercoastal							
		MAD-HR-MRU-3	’17, ’19			’19, ’20		‘19

Sub-division	Zone	SAU	Years monitored Sediments			Years monitored biota		
			TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
		IT-NAS-C	’15, ’16, ’17, ‘18, ‘19	’16, ’17, ‘18, ‘19	’16, ’17, ‘18, ‘19	’16, ‘17, ’18	’16, ‘17, ’18	’16, ‘17, ’18
		MAD_SI_ MRU_11	‘19	, ‘15, ‘16, ‘19		‘21	’16,’17, ’18, ’19, ’20, ‘21	
	NAS offshore							
		IT-NAS-O	’16,’17, 18, ‘19	’16, ’17, ‘18,	’16, ’17, ‘18,	’15, ’16, ‘17		
		MAD_SI_ MRU_12	‘19	‘19		’17, ’18, ’19, ’20. ‘21	’17, ’18, ’19, ’20. ‘21	
Central Adriatic (CAS)								
	CAS coastal/intercoastal							
		MAD-HR-MRU-2	’17, ‘19			’19, ’20		‘19
		IT-CAS-C	’15, ’16, ’17, ‘18, ‘19	’16, ’17, ‘18				
	CAS offshore							
		IT-CAS-O	’15, ’16, ’17, ‘18,	’16, ’17, ‘18		’15, ’16, ‘17		
		MAD-HR-MRU_4	’17, ‘19					
South Adriatic (SAS)								
	SAS coastal/intercoastal							
		MAD-HR-MRU_2	’17, ‘19			’19, ’20		‘19
		IT-SAS-C	’15, ’16, ’17, ‘18, ‘19			’15, ’16, ’17, ‘18,		
		MNE-1	’16, ’17, ’19, ’20, ‘21	’18, ’19, ’20, ‘21	’19, ’20, ‘21	’19, ’20	’19, ’20,	’19, ’20
		AL-C	‘20					

Sub-division	Zone	SAU	Years monitored Sediments			Years monitored biota		
			TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
	SAS offshore							
		IT-SAS-O	’16, ‘17					
		MNE-12	’19, ‘21	’18, ’19, ’20, ‘21	’19, ’20, ‘21	‘18, ’19, ‘20		’19, ‘20
		AL-O	‘20					
		MAD-EL-MS-AD	‘18	‘18				

Annex IX (CH 4.3.4):

The spatial assessment units (SAUs) along with the spatial and temporal coverage of monitoring data collected for the Western Mediterranean Sub-region

Table I. The spatial assessment units (SAUs) for the Western Mediterranean Sea Sub-region and their respective surface area (km^2) and number of monitoring stations located in the SAUs.

Sub-division	**IMAP Assessment Zone**	**IMAP SAU**	**IMAP subSAU**	**Area (km^2)**	**No stations**	**No of stations with data 2016-2022**	**% Area covered by data**
Alboran Sea (ALBS)							
	ALBS coastal						**84 %**
		ALBS-MO-C					
			MO-Gib-A-C	71	-	-	
			MO-Gib-B-C	67	2	2	
			MO-East-C	700	6	6	
			MO-Central-A-C	805	-	-	
			MO-Central-B-C	361	6	6	
			MO-West-C	286	6	6	
		ALBS-ES-C		1908	12	5	
		ALBS-ALG					
			ALG-1A-C	702	3	-	
	ALBS offshore				**-**		**0 %**
		ALBS-MO-O					
			MO-East-O	1020	1	-	
			MO-Central-A-O	1449	1	-	
			MO-Central-B-O	706	1	-	
			MO-West-O	465	-	-	
			MO-Gib-A-O	363	1	-	
			MO-Gib-B-O	302	-	-	
		ALBS-ES-O		23093	6	-	
		ALBS-ALG-O					
			ALG-1A-O	547	1	-	

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP subSAU	Area (km^2)	No stations	No of stations with data 2016-2022	% Area covered by data
Central part of Western Mediterranean Sea (CWMS)							
	CWMS coastal						**67 %**
		CWMS-ALG-C					
			ALG-1B-C	436	-		
			ALG-2-C	322	5	-	
			ALG-3-C	1081	6	-	
			ALG-4-C	337	1	-	
			ALG-5-C	414	4	-	
			ALG-6-C	349	5	-	
			ALG-7-C	534	4	-	
			ALG-8-C	1022	3	-	
			ALG-9-C	980	7	-	
			ALG-10-C	596	8	-	
		CWMS-ES-C					
			ES-CWM-LEV1-C	5547	23	11	
			ES-CWM-LEVOS1-C	3774	5	3	
		CWMS-FR-C					
			FR-CWM-E1-C	20	4	2	
			FR-CWM-E2-C	1923	40	22	
			FR-CWM-C-C	702	14	13	
			FR-CWM-W-C	293	21	21	
			FR-CWM-Corse-C	1497	12	8	
		CWMS-IT-C					
			IT-CWM-C	804	24	23	
			IT-CWM-SarW-C	3926	22	2	

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP subSAU	Area (km²)	No stations	No of stations with data 2016-2022	% Area covered by data
			IT-CWM-Sic-N-C	6	-	-	
		CWMS-TU-C					
			TU-1-C	509	1		
			TU-2-C	2357	4		
	CWMS offshore						**69 %**
		CWMS-ALG-O					
			ALG-1B-O	547	-	-	
			ALG-2-O	426	-	-	
			ALG-3-O	1696	1	-	
			ALG-4-O	971	-	-	
			ALG-5-O	518	-	-	
			ALG-6-O	488	1	-	
			ALG-7-O	1327	-	-	
			ALG-8-O	1523	-	-	
			ALG-9-O	1286	-	-	
			ALG-10-O	733	2	-	
		CWMS-ES-O					
			ES-CWM-LEV1-O	67828	19	13	
			ES-CWM-LEVOS1-O	153876	1	1	
		CWMS-IT-O					
			IT-CWM-O	14239	-	-	
			IT-CWM-SarW-O	76713	-	-	
			IT-CWM-SicN-O	5842	-	-	
		CWMS-FR-O					
			FR-CWM-E1-O	180	-	-	
			FR-CWM-C-O	2823	-	-	
			FR-CWM-E2-O	4865	-	-	

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP subSAU	Area (km^2)	No stations	No of stations with data 2016-2022	% Area covered by data
			FR-CWM-W-O	2179	-	-	
			FR-CWM-Corse-O	5673	-	-	
		CWMS-TU-O					
			TU-1-O	2676	2	-	
			TU-2-O	742	-	-	
Tyrrhenian Sea (TYRS)							
	TYRS coastal						**100% (98% for seds)**
		TYRS-FR-C					
			FR-TYR-Corse-C	648	10	4	
		TYRS-IT-C					
			IT-TYR-1-C	6363	15	15	
			IT-TYR-3-C	4122	9	9	
			IT-TYR-4-C	8072	26	21	
			IT-TYR-5-C	2685	5	-	
			IT-TYR-SarE-C	2598	20	6	
			IT-TYR-SicN-C	3023	26	26	
	TYRS offshore						**0%**
		TYRS-FR-O					
			FR-TYR-Corse-O	5994	-	-	
		TYRS-IT-O					
			IT-TYR-1-O	4178	-	-	
			IT-TYR-2-O	178065	-	-	

Table II: Spatial coverage of monitoring data collected for the Western Mediterranean Se Sea. The number of monitoring stations in the IMAP SAUs of the Western Mediterranean coastal SAUs per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) is shown.

Sub-division	**IMAP Assessment Zone**	**IMAP SAU**	**SubSAU**	**No stations**			**No stations**		
				sediment			**biota**		
				TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
Alboran Sea (ALBS)									
	ALBS coastal								
		ALBS-MO-C							
			MO-East-C	5			2		
			MO-Central-A-C						
			MO-Central-B-C	1			5		
			MO-West-C	2			4		
			MO-Gib-A-C	2					
			MO-Gib-B-C						
		ALBS-ES-C					5		2
		ALBS-ALG							
			ALG-1A-C						
Coastal part of Western Mediterranean Sea (CWMS)									
	CWMS coastal								
		CWMS-ALG- C							
			ALG-1B-C						
			ALG-2-C						
			ALG-3-C						
			ALG-4-C						
			ALG-5-C						
			ALG-6-C						
			ALG-7-C						
			ALG-8-C						
			ALG-9-C						
			ALG-10-C						
		CWMS-ES-C							

Sub-division	**IMAP Assessment Zone**	**IMAP SAU**	**SubSAU**	**No stations**			**No stations**		
				sediment			**biota**		
				TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
			ES-CWM-LEV1-C	3	3	3	9		7
			ES-CWM-LEVOS1-C	3	3	3			
		CWMS-FR-C							
			FR-CWM-E1-C	1			1	1	1
			FR-CWM-E2-C	9			13	13	13
			FR-CWM-C-C	3			13	13	13
			FR-CWM-W-C	2			8	8	8
			FR-CWM-Corse-C	4			4	4	4
		CWMS-IT-C							
			IT-CWM-C	23	23	23			
			IT-CWM-SarW-C	2					
			IT-CWM-Sic-N-C						
		CWMS-TU-C							
			TU-1-C						
			TU-2-C						
Tyrrhenian Sea (TYRS)									
	TYRS coastal								
		TYRS-FR-C							
			FR-TYR-Corse-C	2	2	2	4	4	4
		TYRS-IT-C							
			IT-TYR-1-C	14	14	14			
			IT-TYR-3-C	9	9	9			
			IT-TYR-4-C	21	21	9			
			IT-TYR-5-C						
			IT-TYR-SarE-C	6					
			IT-TYR-SicN-C	26	26	26			

Table III: Temporal coverage of the monitoring data collected for the Western Mediterranean Sea. The years of data collected per SAU and per contaminant group (trace metals (TM), PAHs, PCBs) are shown.

Sub-division	IMAP Assessment Zone	IMAP SAU	SubSAU	Years monitored			Years Monitored		
				sediment			biota		
				TM	PAHs	PCBs	TM	PAHs	PCBs
Alboran Sea (ALBS)									
	ALBS coastal								
		ALBS-MO-C							
			MO-East-C	‘17, 18			’20, ‘21		
			MO-Central-A-C						
			MO-Central-B-C	‘17, ‘18			‘17, ’18, ’20, ‘21		
			MO-West-C	‘17, ‘18			‘17, ‘18		
			MO-Gib-A-C	‘17, ‘18					
			MO-Gib-B-C						
		ALBS-ES-C					‘17, ‘19		‘17, ‘19
		ALBS-ALG							
			ALG-1A-C						
Coastal part of Western Mediterranean Sea (CWMS)									
	CWMS coastal								
		CWMS-ALG- C							
			ALG-1B-C						
			ALG-2-C						
			ALG-3-C						
			ALG-4-C						
			ALG-5-C						
			ALG-6-C						
			ALG-7-C						
			ALG-8-C						
			ALG-9-C						
			ALG-10-C						

Sub-division	IMAP Assessment Zone	IMAP SAU	SubSAU	Years monitored			Years Monitored		
				sediment			biota		
				TM	PAHs	PCBs	TM	PAHs	PCBs
		CWMS-ES-C							
			ES-CWM-LEV1-C	‘16	‘16	‘16	‘17, ‘19		‘17, ‘19
			ES-CWM-LEVOS1-C	‘16	‘16	‘16			
		CWMS-FR-C							
			FR-CWM-E1-C	‘16			‘18	‘18	‘18
			FR-CWM-E2-C	‘16			’18,’19, ’20, ‘21	’18,’19, ’20, ‘21	’18,’19, ’20, ‘21
			FR-CWM-C-C	‘16			’18,’19, ’20, ‘21	’18,’19, ’20, ‘21	’18,’19, ’20, ‘21
			FR-CWM-W-C	‘16			’18,’19, ’20, ‘21	’18,’19, ’20, ‘21	’18,’19, ’20, ‘21
			FR-CWM-Corse-C	‘16			’18, ‘19	’18, ‘19	’18, ‘19
		CWMS-IT-C							
			IT-CWM-C	’16, ‘20	’16, ‘20	’16, ‘20			
			IT-CWM-SarW-C	’17, ‘19					
			IT-CWM-Sic-N-C						
		CWMS-TU-C							
			TU-1-C						
			TU-2-C						
Tyrrhenian Sea (TYRS)									
	TYRS coastal								
		TYRS-FR-C							
			FR-TYR-Corse-C	’16,			’18,’19, ’20, ‘21	’18,’19, ’20, ‘21	’18,’19, ’20, ‘21
		TYRS-IT-C							
			IT-TYR-1-C	’17,’18, ’19, ‘20	’17,’18, ’19, ‘20	’17,’18, ’19, ‘20			
			IT-TYR-3-C	’17, ‘20	’17, ‘20	’17, ‘20			
			IT-TYR-4-C	’17, ‘20	’17, ‘20	’17, ‘20			
			IT-TYR-5-C						
			IT-TYR-SarE-C	’17, ‘19					
			IT-TYR-SicN-C	‘20	‘20	‘20			

Annex X
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