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10th Meeting of the Ecosystem Approach Coordination Group

Istanbul, Türkiye, 11 September 2023

Agenda Item 4: 2023 Mediterranean Quality Status Report

Report of the Meeting of the Ecosystem Approach Correspondence Group on Monitoring (CORMON) Pollution – Videoconference, 27 and 30 March 2022

UNEP/MAP
Athens, 2023

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Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring

Videoconference, 27 and 30 May 2022

Report of the Meeting

UNEP/MAP
Athens, 2022

Table of Contents

Introduction

1. In accordance with the UNEP/MAP Programme of Work adopted by COP 22 for the biennium 2020-2021, the United Nations Environment Programme/Mediterranean Action Plan-Barcelona Convention Secretariat (UNEP/MAP) and its Programme for the Assessment and Control of Marine Pollution in the Mediterranean (MED POL) organized the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (CorMon on Pollution Monitoring). The Meeting was held via videoconference on 27 and 30 May 2021.

2. The main objectives of the Meeting were to:

a) Review and approve upgraded assessment criteria for IMAP CI 17 at the regional and sub-regional levels;
b) Review and approve the proposal of the new reference and boundary values for TP and DIN related to IMAP CI 13 in the Adritic Sea Sub-region;
c) Review detailed elaboration of NEAT tool application for GES assessment for IMAP CI 17 in the Adriatic Sea Sub-region, along with related GES assessment findings;
d) Review and approve the methodology proposed for assessing the status of the marine environment in the areas with limited data reported within the GES assessment for IMAP CI 17, along with related GES assessment findings in the Levantine Sea Basin;
e) Adopt Data Standards and Data Dictionaries for IMAP Common Indicators 18 and 20 further to their elaboration undertaken to address the proposals of the Meeting of CorMon on Pollution (26 to 28 April 2022).

Agenda item 1: Opening of the Meeting

3. The Meeting was opened by Mr. Mohamad Kayyal, the Programme Management Officer of the Mediterranean Pollution Assessment and Control Programme (MED POL). He elaborated on the Agenda of the Meeting emphasizing the importance of the outcomes of this meeting for achieving the key progress towards the preparation of the IMAP Pollution Chapters of the 2023 MED QSR.

4. The Meeting was attended by representatives from the following Contracting Parties: Albania, Bosnia and Herzegovina, Croatia, Cyprus, Greece, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Spain, Tunisia and Turkiye.

5. The following United Nations bodies, specialized agencies, secretariats and intergovernmental organizations were represented as observers: the European Environmental Agency (EEA), the European Marine Observation and Data Network (EMODNET), the International Atomic Energy Agency Marine Environment Studies Laboratories (IAEA - MESL), the Union for the Mediterranean (UfM) , the Istituto Nazionale di Oceanografia e di Geofisica (OGS) and the Mercator Ocean International.

6. The following non-governmental organizations and other institutions were represented as observers: the Center for Energy, Environment and Resources, the Centre International de Droit Comparé de l'Environnement (CIDCE) and the ECAT Tirana.

7. The United Nations Environment Programme (UNEP), including the Secretariat of the Barcelona Convention was represented by the Programme for the Assessment and Control of Marine Pollution in the Mediterranean (MED POL). The following MAP Components also participated in the Meeting: the Plan Blue Regional Activity Center (BP/RAC), the Regional Activity Centre for Information and Communication (INFO/RAC), the Priority Actions Programme Regional Activity Centre (PAP/RAC) and the Regional Marine Pollution Emergency Centre for the Mediterranean Sea (REMPEC).

8. The full list of participants is attached to the present report as Annex I.

Agenda items 2: Organizational Matters

a) Rules of Procedure for the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (CorMon on Pollution Monitoring

9. The rules of procedure for meetings and conferences of the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols applied mutatis mutandis to the present Meeting (UNEP/IG.43/6, Annex XI).

b) Election of officers

10. In accordance with the Rules of procedures for meetings and conferences of the Contracting Parties, the Meeting elected one (1) President, three (3) Vice-Presidents and one (1) Rapporteur from among the participants, as follows:

Chair:	Mr. Milad Fakhry, Lebanon
Vice-Chair:	Mr. Lassaad Chouba, Tunisia
Vice-Chair:	Ms. Mateja Poje, Slovenia
Vice Chair:	Mr. Mohammed El Bouch, Morocco
Rapporteur:	Ms. Selma Cengic, Bosnia and Herzegovina

c) Adoption of the Provisional Agenda

11. The proposed Provisional agenda appearing in document UNEP/MED WG.533/2, was adopted without changes.

d) Organization of Work

12. Discussions were held in online plenary sessions, as follows:
- 27 May 2022: 10:00-12:00; 12:30-14:30; 15.30-17:30, (EST- Athens time).
- 30 May 2022: 10:00-12:00; 12:30-14:30; 15.30-17:30 (EST- Athens time).

Simultaneous interpretation into English and French was provided during the Meeting.

Agenda item 3: Assessment Criteria

1. Ms. Jelena Knezevic, UNEP/MAP Monitoring and Assessment Officer, presented the Working Documents WG.533/3 on the Adjusted Background (Assessment) Concentrations (BC/BAC) for Common Indicator 17 and Upgraded Approach for Environmental Assessment Criteria (EAC) for IMAP Common Indicators 17, 18 and 20 that is complemented by the Information Document UNEP/MED WG.533/Inf.3. First, she explained the present status of data reporting regarding IMAP Common Indicators 13, 14, 17, 18, 20 and 21, by providing details on the gaps still present regarding quality assurance of data and data quality control, as well as the problems with IMAP Pilot Info System functioning. She also informed on the status of preparation of the initial assessment inputs for the 2023 MED QSR, by providing details on the assessment methods applied and perspectives for preparation of the final assessment products. She proceeded by presenting the Background Assessment Concentrations (BACs)/Background Concentrations (BCs) for IMAP CI 17 as upgraded by using monitoring data reported from February to December 2021 with a view to addressing the requests and comments received from the members of the Online Working Group on EO 9; the Meeting of CorMon on Pollution (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). In that regard, she explained the revisions undertaken to upgrade the assessment criteria including the elaboration of the normalization procedure; the use and statistical treatment of BDL values; and the use of the

multiplication factor to calculate BACs for TEs, OCs and PAHs. She also provided details regarding: i) the proposal of the EAC values for IMAP Common Indicator 20 proposed for assessment of the Good Environmental Status in line with the concentration limits for the contaminants regulated in EU Commission Regulations (EC) No. 1881/2006, (EC) No. 835/2011 and EC No. 1259/2011, and ii) the use of 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. The explanations were also provided regarding the approaches proposed for future upgrades of EAC values for IMAP Common Indicators 17, 18 and 20 that will take place as of 2024. She concluded by pointing out that the present document UNEP/MED WG.533/3 was being submitted for approval of the present Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring in terms of 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 (GES) assessment within the preparation of the 2023 MED QSR, along with accepting proposed approaches for upgrade of EAC for IMAP Common Indicators 17, 18 and 20.

2. After the introductory elaboration, the Working document UNEP/MED WG.533/3 was placed on the screen for the consideration and comments of the meeting participants.

3. A few meeting participants expressed appreciation for the revision of the document undertaken by the Secretariat in line with their comments provided during the Meeting of CorMon on Pollution; the Resumed session of the Meeting of MED POL Focal Points; and the 8th EcAp Coordination Group Meeting.

4. Several meeting participants explained the difficulties they faced which did not allow them to timely report the monitoring data, expressing also their expectation that the situation should improve regarding the implementation of national monitoring programmes.

5. In responding to the questions and comments of a few participants related to the use of data since 2005 and their status, the Secretariat explained that the present upgrade of the assessment criteria is based on new national monitoring data received up to 31st December 2021 that have not been previously used for the calculation of the assessment criteria in 2017 and 2019. In addition, following the recommendation of the OWG on Contaminants, data since 2015 were used as well in present calculation, even if used in the previous assessments. The Secretariat also explained that data were used even if they were not formally validated due to issues that affected the misfunctionality of the IMAP Info System; noting at the same time that all data were used only after undertaking their quality control in close collaboration with national IMAP users.

6. One meeting participant asked for a demonstration of statistical treatment of the limit of quantitation (LOQ) and below detection limit (BDL) values provided by the countries given high limit values proposed for the Adriatic Sea Sub-region. By providing a demonstration of the use of limit of detection (LOD) or the limit of quantitation (LOQ) values, the Secretariat explained that the calculation was performed by using these values as provided by the CPs, i.e., the reported values were addressed as BDL values which were taken in the calculation of the new proposed BCs, even though the BDL values were different, depending on the country and even different within the same country. Moreover, BDL values constituted 12 to 90% of the data points depending on the compound. By showing the steps undertaken within the calculation, the Secretariat explained that detailed elaboration is provided in section 4.1 of UNEP/MED WG.533/Inf.3, including a detailed overview of all BDL values reported by the CPs. Given that exclusion of the BDL concentrations might artificially increase the calculated BC values in this document, the calculations were performed with the BDL values as reported by the CPs. It was also recognized that the different BDL values made it hard to use half of the BDL concentration.

7. A few meeting participants advised on using the proposed values of BAC/BC with caution due to the lack of data for their reliable calculation, asking for an explanation about differences in values proposed at sub-regional and regional levels, as well as their application for the assessment purposes. The Secretariat explained that values are proposed for their use within the preparation of the assessment inputs for 2023 MED QSR while work on their regular upgrade will continue as of 2024 conditional to regular reporting of monitoring data by the Contracting Parties. The Secretariat added

that these are proposed per every mandatory contaminant per 4 sub-regions and the Mediterranean region, as provided in Tables 9 -13 in section 4.1 noting that for some parameters, there is a marked difference among the Mediterranean sub-regions; therefore, the Secretariat proposes in those cases (i.e. Cd and Hg in sediments, Cd in *M. galloprovincialis,* the sum of PAHs in sediments) to consider using the sub-regional Mediterranean Sea assessment criteria. Where a lack of data prevented the calculation of the sub-regional values of the BC/BACs, the Secretariat recommends to continue applying regional values. The application of the proposed BC/BAC values is elaborated in the meeting documents UNEP/MED WG.533/5 and UNEP/MED WG.533/6 elaborating NEAT and CHASE+ assessment methodologies.

8. Other meeting participants commented on the necessity to use biota species - specific to different sub-regions/sub-areas, explaining that *M. galloprovincialis* and *M. barbatus*, as mandatory species within IMAP implementation, are not spread all over the Mediterranean. The Secretariat agreed with this opinion and explained that the addition of other species to the monitoring programme is recommended for further consideration, based on their presence in the sub-regions, and relevance as indicators of pollution, within the revision of IMAP that is expected to take place in the period as of 2024.

9. A few meeting participants proposed adding the grain size parameter to the database given the variability of concentrations in sediment is related to grain size. The Secretariat explained that although the grain size is data that needs to be reported by the CPs in IMAP Pilot Info System, most CPs report neither grain size nor normalizers. Regarding the proposal to include the normalizers in the inter-calibration exercises, the Secretariat confirmed that it will be included in the Report of the Meeting, adding that normalization is elaborated in Section 2.2.5 of UNEP/MED WG.533/Inf.3.

10. One meeting participant took the floor proposing flexibility in the use of proposed BCs/BACs due to the variability of their values upgraded in 2017, 2019 and 2022. In that regard, an agreement was reached on adding the following explanation in paragraph 36: “It is noted that when applying the environmental quality assessment using the BAC, their large variability (up to >100%), as presented in the re-calculated values for 2017, 2019 and 2022, should be considered. Thus, it is suggested to consider this variability for each sub-region or basin-wide in assessing GES. It should be noted that in the GES assessment the choice of thresholds should take this uncertainty into account.”

11. One meeting participant, supported by another, explained that BC for PCBs, as anthropogenic substances, should be zero and consequently, the value calculated based on analytical precision, should be defined as BAC. The Meeting agreed to amend paragraph 14 as follows: “Therefore, the assessment of enrichment or bias from BC (zero) should consider the analytical limitations and methodological uncertainties. Hence it is to apply the lowest analytical threshold and define it as BAC solely for such anthropogenic substances. The BACs used here (paragraph 44, Table 13) for organochlorides is therefore based on the detection limits of the methods used and its uncertainty (precision and accuracy), as determined from CRMs (Certified reference materials) and proficiency testing.” The Meeting agreed to make this correction (i.e. replacing BC with BAC) also in paragraph 44 and Table 13.

12. Another meeting participant suggested to further discuss regarding EAC values. The Secretariat responded that EAC values cannot be updated given that very specific ecotoxicological data are needed. The Secretariat noted that these data are not included in data reporting to IMAP Info System. The EAC values endorsed for use in the Mediterranean Sea are NOAAs ERLs as applied by OSPAR (for TM, PAH and pesticides in sediments) and the ECs from EU Directives to protect human health (for TM and organic contaminants in biota), as established by Decisions IG.22/7 (COP 19)[1] and IG.23/6 (COP 20);[2] adding that they may be too lenient for achieving and maintaining GES where the contaminants cause no significant impact on coastal and marine ecosystems. The Secretariat indicated that upgrade of the EAC values for Mediterranean Sea is elaborated in the document in line with the methodology detailed in European Commission Guidance Document (2018) and in Long et al. (1995),

[1] UNEP/MAP (2015). Decision IG.22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (Annex II), (COP 19, 2015).
[2] UNEP/MAP (2017). Decision IG.23/6 on Mediterranean Quality Status Report (COP20, 2017).

noting that it is a long-term task that needs a dedicated, very specific, scientific research as elaborated in UNEP/MED WG.533/Inf.3.

13. One meeting participant proposed deleting the rows providing the minimum and maximum levels as provided in Table 14 for trace metals in fish and seafood for the protection of human health. The Secretariat explained that minimum and maximum levels are provided in the source documents as elaborated in Table 14. The Meeting accepted to delete the last two rows and to add an explanation that Table 14 presents the maximum permitted levels for contaminants in fish and seafood for the protection of human health.

14. Following the review and discussion of the Working Document UNEP/MED WG.533/3, the Meeting agreed on using: (a) the upgraded BC and BAC values for IMAP Common Indicator 17 as well as EAC values for IMAP Common Indicator 20 for GES assessment within the preparation of the 2023 MED QSR; and (b) the approaches proposed for future upgrades of EAC values for IMAP Common Indicators 17, 18 and 20 that will take place as of 2024. The Meeting 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.

15. Accordingly, the Meeting approved Working Document UNEP/MED WG.533/3 as amended with supplementary information provided during the discussion and recommended its submission to the MED POL FPs Meeting, which will be held in May/June 2023.

16. In the continuation of the Meeting, the UNEP/MAP Monitoring and Assessment Officer, presented the Working Document WG.533/4 on the assessment criteria methodologies for IMAP Common Indicator 13. She explained that the present document elaborates a practical application of the methodological approach that was provided in UNEP/MED WG.492/11 for the calculation of the reference conditions and the boundary values for DIN and TP in the Adriatic Sea Sub-region. 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. These assessment criteria were limited to the Adriatic Sea Sub-region due to lack of data reported by the CPs in other sub-regions/sub-areas. The Secretariat indicated that the present document addresses the requests and comments as received from the members of the Online Working Group on Eutrophication; the Meeting of CorMon on Pollution (26-28 April 2021); the Resumed session of the Meeting of the MED POL Focal Points (9 July 2021); and the 8^{th} EcAp Coordination Group Meeting (9 September 2021). . She concluded by pointing out that the present document UNEP/MED WG. 533/4 was submitted for approval of present Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring in terms of using the reference conditions and boundary values for Dissolved Inorganic Nitrogen (DIN) and Total Phosphorous (TP) for Good Environmental Status (GES) assessment of the Adriatic Sea Subregion within the preparation of the 2023 MED QSR.

17. After the introductory elaboration, the Working document UNEP/MED WG.533/4 was placed on the screen for the consideration and comments of the meeting participants.

18. One meeting participant requested deletion of Slovenia from Type I waters in Table 3 in order to ensure its alignment with Figure 2 providing the distribution of water types on the monitoring stations that were used to propose sub-regional assessment criteria for the Adriatic Sea sub-region. The Meeting agreed with the correction which is included in paragraph 35 of the document and Table 7.

19. The meeting participant also sought an explanation if the finding that the concentration of DIN can explain up to 40% of the concentration of Chl*a*, as provided in paragraph 30, which refers to Water type I. In responding to this question, the Secretariat confirmed that for Water type I, for which the amount of the total Chl*a* variability as explained by the stepwise regression technique, is up to 43% and the maximum weight in determining this variability accounts for DIN. The Secretariat added that findings must be further tested conditional to sufficient new data reporting, noting that the present

document is elaborated on the relationships that were tested at the level of the whole Adriatic, as data availability for the eastern part of the Adriatic does not allow testing these aspects at more detailed scales. A similar finding is true for Water type II for which the amount of the total Chl*a* variability explained by the stepwise regression technique is only 23% with a largely dominant weight of TP and DIN over the weight of FDil.

20. Another meeting participant asked for an explanation of the depth of offshore waters. The Secretariat responded that conditions pertaining to coastal and open/offshore waters are not standardized within IMAP, but for the purpose of IMAP implementation, the coastal waters are usually considered up to a depth of 20 meters, taking into consideration also the hydrographic conditions. The meeting participant brought about the specific conditions in the Gulf of Gabes where a depth of 20 meters is reached at a distance of 25 to 30 kilometers from the coastline.

21. Following up on this discussion point, another four participants requested to add a definition of the coastal waters for the purpose of the present calculation of the assessment criteria. Given that present work follows the previous work undertaken within OWG on Eutrophication that led to the setting of reference and boundary conditions for Chl*a*, as provided in Decisions IG.22/7 (COP 19), the Meeting requested to follow the same approach within the present work, i.e., to include the definition from the EU Water Framework Directive.

22. In responding to this proposal, the Secretariat suggested adding a new paragraph in Section 1. The Meeting agreed on adding the following new Paragraph 7: "For the purpose of setting the assessment criteria 'Coastal water' means surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured."

23. While thanking the Secretariat for the comprehensive work undertaken, , one participant expressed the opinion that reporting three continuous years of monitoring data, with a minimum monthly frequency for Water types I and IIA and bimonthly to seasonal for Water type III and in reference to the calculation of reliable reference conditions and boundary values as elaborated in Paragraph 40will be difficult given limited resources available for implementation of the national monitoring programmes by the CPs.

24. The Meeting concluded that the present upgrade of the assessment criteria related to IMAP Common Indicators 13 and 14 was possible to define only for the Adriatic Sea Sub-region coastal and open (offshore) waters due to limited data availability from other sub-regions.

25. Following the review and discussion of the Working Document UNEP/MED WG.533/4, the Meeting agreed on 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 shown in Table 9, 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).

26. The Meeting approved Working Document UNEP/MED WG.533/4 as amended with supplementary information provided during the discussion, and recommended its submission to the MED POL FPs Meeting, which will be held in May/June 2023.The final conclusions and recommendations of the Meeting related to this agenda item are presented in Annex III, including Working Document UNEP/MED WG.533/3 and related Information Document UNEP/MED WG.533/Inf.3, as well as Working Document UNEP/MED WG.533/4, as revised and approved by the Meeting.

Agenda item 4: GES Assessment for IMAP Common Indicator 17 based on the Application of the NEAT Tool in the Adriatic Sea Sub-region

27. The UNEP/MAP Monitoring and Assessment Officer, presented the Working Document WG.533/5 on the methodology and the results of the NEAT tool application for GES assessment of IMAP Common Indicator 17 in the Adriatic Sea Sub-region that is complemented by Information Documents UNEP/MED WG.533/Inf. 4 and UNEP/MED WG.533/Inf.5. She explained that 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, this document provides detailed elaboration of NEAT application for GES assessment of IMAP CI 17 in the Adriatic Sea Sub-region. The work was undertaken by considering the conclusions of the Meeting of CorMon on Pollution Monitoring (Teleconference, 26-27 April 2021) and the Meeting of the MED POL Focal Points (Resumed Session, 9 July 2021). Further to recommendation of MEDPOL Focal Points to return Working Document UNEP/MED WG.509/10/rev.2 “Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster” to the CorMon for further clarifications from technical and scientific considerations with a view to avoid possible confusion with the scope/mandate of the Barcelona Convention and its Protocols, 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. She noted that this includes optimal temporal and spatial integration and aggregation of the assessment findings within a nested approach agreed upon for IMAP implementation. All contaminants’ data are aggregated and integrated spatially and also per habitat (sediments, mussels) while the various levels of spatial integration (nesting) are provided to ensure meaningful scaling of the assessment findings. Furthermore, she elaborated on the GES assessment findings prepared for the Adriatic Sea Sub-region that are scaled to the levels considered meaningful for IMAP CI 17. Thereby, the GES assessment results are provided by applying NEAT tool on the spatial scope of the finest areas of assessment and the areas of assessment which are also nested to the levels of integration that are considered meaningful for IMAP CI 17. She indicated that detailed elaboration is provided in UNEP/MED WG.533/Inf.4 and UNEP/MED WG.533/Inf.5, and further summarized in the first chapter of this Working Document UNEP/MED WG.533/5. She expressed expectation that the present document will be approved by the Meeting in terms of the GES assessment results provided for the Adriatic Sea Sub-region and further application of the NEAT tool in other sub-regions/areas with sufficient data for GES assessment.

28. After the introductory elaboration, the Working Document UNEP/MED WG.533/5 was placed on the screen for the consideration and comments of the meeting participants.

29. One meeting participant took the floor requesting three footnotes to be added in order to better clarify the nature of the present document and its interrelation with the Working Document UNEP/MED WG.509/10/rev.2 which was discussed at the Resumed Session of the Meeting of the MED POL Focal Points (9 July 2021). The first footnote repeated an explanation that was already included in the footnote added to paragraph 4; this footnote reads as follows: “For the purpose of building the methodology for aggregation and integration rules contained in this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes”. The second footnote provides the following explanation: “No action or activity taken on the basis of this document shall be interpreted or considered as prejudging position of the Contracting Parties on the land or maritime sovereignty dispute or dispute concerning the delimitation of the maritime areas.” The third footnote refers to the following conclusion of the Meeting of CorMon on Pollution Monitoring (Videoconference, 26-27 April 2021): “The Meeting reviewed Working Document UNEP/MED WG.509/10/rev.2 ‘Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster.’ The Meeting appreciated the work quality and in-depth analysis undertaken by the Secretariat to develop the proposed integration and aggregation methodology. The Meeting did not reach a consensus on the document, and although some Contracting Parties (Croatia, Bosnia and Herzegovina, Montenegro, Greece) were in favor of submitting the document to the EcAP Coordination Group, the Meeting recommended that the document be returned to the CorMon for further clarifications from technical and scientific considerations with a view to avoiding possible confusion with the scope/mandate of the Barcelona Convention and its Protocols. The Meeting also requested the Secretariat to include in the report of the meeting information on the reasons why the First Session of the MED POL Focal Points Meeting decided to remove document WG.509/inf.14 from the list of documents.”

30. Another meeting participant asked for clarification of the footnotes proposed for inclusion in paragraph 1, whereby their inclusion was supported by a third meeting participant. After providing the explanation by the Secretariat, the Meeting agreed on the proposed amendment to Paragraph 1.

31. The amendment was included in Paragraphs 1, 2 and 14 by replacing the reference to the Working Document UNEP/MED WG.492/13 with UNEP/MED WG.509/10/Rev.2 in order to interrelate the present document with the latest version of the document on integration and aggregation rules as discussed at the Resumed Session of the Meeting of MED POL Focal Points (July 2021).

32. One meeting participant asked for correction of information documents regarding the source used to set the finest IMAP spatial assessment units by replacing i) the word “subMRUs” with the words “water bodies” and ii) “Marine Strategy Framework Directive” with “Water Framework Directive” in Figure 5 of Information Document UNEP/MED WG.533/Inf.4 and in Figure 20 of Information Document UNEP/MED WG.533/Inf. 5.

33. Another meeting participant asked for adding the following footnote in paragraph 21, as well as in Information document UNEP/MED WG.533/Inf.4, with a view to better explain the present status of contaminants monitoring in its sea area: “Bosnia and Herzegovina has not been included in present GES assessment due to lack of data on contaminants as explained in the following text, however, IMAP SAUs were set for B&H as explained in UNEP/MED WG.533/ Inf. 5”.

34. One meeting participant asked for correcting the abbreviation for the name of her country by replacing “SL” with “SI” in Figure 2 of the present document, as well as all related diagrams and related Information Documents, as appropriate.

35. One meeting participant expressed concern about harmonization of the assessment findings in the marine areas of his country located in different Mediterranean sub-regions. The Secretariat responded that a comparison of different assessment methodologies has already been undertaken in order to harmonize the setting of boundary limits between GES and non-GES status in the Adriatic Sea sub-region and the Levantine Sea Basin. This approach will also be applied in all other sub-regions/sub-areas that will be assessed during the 2023 MED QSR preparation.

36. Another meeting participant asked for an explanation of the rationale for applying NEAT GES assessment methodology versus traffic light comparison of measured concentrations against thresholds. He also asked for clarification of setting the three non-GES classes.

37. The Secretariat explained that the NEAT GES assessment supports the integration and aggregation of the assessment findings along the IMAP nesting scheme. That approach ensures spotting hot spots as well. It also 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. Consequently, it ensures optimal and scientifically justifiable discrimination among the GES – nonGES assessment classes. The 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. These values are mandatory by the tool which then linearly produces five status classes, depending on the distance of measured concentrations from the two boundary limit values and the GES-nonGES threshold. The three non-GES assessment classes out of five classes are set to support detailed GES assessment based on the highest distance from the MedEAC, as the GES – nonGES threshold. By comparing NEAT GES assessment and CHASE+ assessment, the interrelation was established between the GES – nonGES thresholds set within application of these methodologies. In such a manner, good balance and harmonization of the assessment findings is ensured.

38. This explanation of the Secretariat was supported by another meeting participant who indicated that NEAT GES assessment ensures demasking of nonGES status, including the use of better discriminated nonGES assessment classes.

39. One meeting participant commented that the GES assessment methodology should not be used to assess the hot spots given the concept of GES has a different approach, i.e., the GES is based on

biological and ecological aspects. GES refers to the ecosystem but not only to the level of contamination. It gives the same weight to polluted areas regardless of the hotspots.

40. The Secretariat agreed with this opinion and added that NEAT GES assessment was not primarily developed to support identification and assessment of the contamination at the hot spot locations. However, it can also be used for the hot spot locations mapping given the lack of biological effects data requires the use of contaminants‘ concentrations.

41. One meeting participant suggested the GES assessment findings per individual PAHs given individual contaminants better explain environmental characteristics. The Secretariat explained that monitoring data are not reported by the CPs per mandatory individual 16 EPA PAHs and 7 PCBs. Therefore, the sum of the 16 EPA compounds (Σ16PAHs) and the sum of the 7 PCBs compounds (Σ7PCBs) were considered for the present assessment. In this way, the assessment results show the cumulative impact of each of these two groups of contaminants.

42. Another meeting participant asked for a specification in Table 2 of the biota species used as a matrix. The Secretariat explained that it refers to *M. galloprovincialis*; accordingly, this specification was included in Table 2.

43. The high values of threshold concentrations that delimit the adjacent GES classes were questioned by two meeting participants. Concern was also expressed regarding the use of 3XMED EAC value as a threshold that delimits moderate and poor classes. The Secretariat explained that the threshold limit between high and good GES assessment classes is based on the assessment criteria as provided in the meeting document UNEP/MED WG.533/3; however, the present document included the values as they were calculated based on data available by end of August 2021 when this assessment was launched. The Secretariat added that the 3x MED EAC threshold value was used since it ensures optimal discrimination between the two adjacent classes; hence, this threshold value between moderate and poor categories does not impact classification in GES and nonGES status. The Secretariat confirmed that the GES assessment findings, as provided in the present document, will be revisited before their inclusion in the 2023 MED QSR by using the values of assessment criteria as agreed in the meeting document UNEP/MED WG.533/3. It will allow checking if eventually lower 2xMED EAC threshold value might also optimally discriminate between moderate and poor classes instead of 3xMED EAC threshold value.

44. One meeting participant added that proposed thresholds among the assessment classes might contradict NOAA’s criteria. In order to ensure flexibility in setting the assessment classes, he suggested and the Meeting agrees on adding the following footnote in the capture of Table 2: “Assessment based on the three nonGES categories should look for more flexibility, especially regarding biota, given the specific nature of impact of each contaminant and the criteria used in other marine areas by other Regional Seas Programmes”.

45. Another meeting participant expressed concern regarding the proposed delimitation among GES and nonGES classes given it is not sufficiently strict. He also asked for an explanation about the integration and aggregation of the results. Answering this question, the Secretariat referred to Sections 1, 5 and 6 of working and information documents UNEP/MED WG.533/5 and UNEP/MED WG.533/Inf.4. The Secretariat explained that data can be aggregated i) either per each contaminant per habitat (i.e., sediments, biota) separately or ii) for all contaminants per habitat (i.e. sediments, biota) within a specific SAU, and then spatially integrated within the nested scheme of SAUs. The first option leads to one value for each chemical compound separately for a specific SAU. The process is then repeated for all nested SAUs (in a weighted or non-weighted mode) and in the end one NEAT value for the larger/nested SAU is obtained (i.e. for the Adriatic Sea) either for each contaminants separately, or for all contaminants by habitat (sediments, biota). The NEAT value per SAU represents the overall chemical status of the SAUs. Table 3 provides detailed assessment results on the EO9/CI 17 level per contaminant that are 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 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). At the same time aggregation of all assessment results is provided 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 3 shows the results per contaminant per habitat per SAU in the finest level which are i) integrated along with 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 with the nesting scheme (column EO9 bold lines). When second option is applied i.e. data are aggregated per habitat, the NEAT tool provides assessment results by aggregating them per habitat, in this case, sediments and biota (mussels), and then spatially integrating them 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 3) or per habitats (Table 4)), as expected.

46. This opinion was followed by a question of another participant who requested an explanation if the values shown in Table 3 present average values. The Secretariat explained that detailed elaboration is provided in Sections 4 and 5 of the working and information documents (UNEP/MED WG.533/5 and UNEP/MED WG.533/Inf. 4). In brief, the Secretariat explained that NEAT aggregates data by calculating the average of normalized values of contaminants (Cd, Pb, PAHs, etc.), boundary limits and threshold values. The values are normalized on a scale of 0 to 1 on the SAU level to be comparable among parameters and to facilitate aggregation on the CI or EO level. Specific boundaries of the indicators (e.g. boundary between moderate and good status) are also normalized. Threshold concentrations are normalized in a 0 to 1 scale as follows: $0 \leq$ bad $< 0.2 \leq$ poor $< 0.4 \leq$ moderate $< 0.6 \leq$ good $< 0.8 \leq$ high ≤ 1.

47. One meeting participant asked for an explanation of weighting factors. She expressed the view that a small area of SAU/subSAU can lead to zero value of weighting factor; therefore, indicating the irrelevance of the small units for aggregated assessment results. The Secretariat explained that the process of distributing the weight per SAUs is more complex. The use of the weighting factor is explained in paragraph 31, while details are elaborated in Annex III. To increase the clarity of this paragraph, the Secretariat proposed, and the Meeting agreed, to add the following formulation: “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 weigh by SAU area: weights are calculated based just on the nesting hierarchy of the SAUs; and ii) weight by SAU area: weights are calculated based on the nesting hierarchy and the SAU surface area. For the present assessment option ii) was followed. In all cases, the number of nesting levels and data availability per SAU is considered in the calculation of weights.”

48. Another meeting participant asked for an explanation of how aggregated values on the upper level can be high or good if there is a moderate status of some of aggregated finest spatial assessment units. The Secretariat explained that the integrated result on the upper SAU level actually reflects the status of subSAUs; however, taking into account the SAU weight factor of the finest subSAUs as provided in the third column. The status of each SAU is reflected by the normalized concentrations’ value i.e. the NEAT value between 0 and 1. Values ≥ 0.6 are considered in GES, because the normalized GES-nonGES threshold value is always assigned as 0.6. During the aggregation - integration process to a higher nesting level, the weighted averaging of the NEAT values may lead to a higher status class. The status of one single SAU for all contaminants is the average of the NEAT values obtained for each contaminant separately. For example, SAU HRO-0313-BAZ = 0.790 (good)+ 0.475 (moderate) + 0.591 (moderate) = 1.856/3 = 0.619 (good). Despite the fact that for two contaminants the status is moderate the overall status is defined as good. This is related to the actual NEAT values i.e., how close or far they fall from 0.6. A similar process, taking into account also the SAU weight factor is followed when aggregating and integrating in an upper SAU level.

49. One meeting participant asked for a full compliance and coherence of the NEAT GES assessment with national assessment approaches set within the implementation of the Marine Strategy Framework Directive. While thanking the Secretariat for the work undertaken to prepared Document UNEP/MED WG.533/5, she expressed reservation regarding this document before the coherence and alignment of the NEAT GES assessment methodology and the national MSFD assessment is confirmed.

50. Another three participants took the floor to support the application of the NEAT GES assessment methodology within the preparation of the MED QSR 2023. One of them explained that this methodology will be followed in setting the national GES assessment approach; therefore, requesting the Secretariat to provide training on its application.

51. In responding to these proposals, the Secretariat explained that the IMAP GES assessment cannot be equalized to the national assessment approach(es). It builds on all relevant practices, including the national ones; however, it is set as the assessment methodology equally applicable to all Contracting Parties sharing a common sub-region. In the case of NEAT GES assessment for IMAP CI 17 in the Adriatic Sea Sub-region, all relevant national sources were used, including those pertaining to MSFD. Details are elaborated in UNEP/MED WG.533/Inf.4 and UNEP/MED WG.533/Inf.5. Regarding the concerned country, the Secretariat noted that national MRUs were used to set IMAP SAUs in its offshore waters, while an additional layer of IMAP subSAUs was added in its coastal waters, however by following the administrative division of the concerned country. The Secretariat indicated that this was necessary in order to ensure a good balance between the size and weights of the spatial assessment units placed in the western and eastern Adriatic Sea Sub-region. The Secretariat reminded that the NEAT tool application on the IMAP nesting scheme for GES assessment was agreed upon by the IMAP Best Practices Meeting (Rome, 12-13 July 2018). In that respect, the Secretariat proposed to the Meeting to approve the Meeting document UNEP/MED WG.533/5, as revised during present discussion, in terms of applying the NEAT GES assessment methodology in the Adriatic Sea Sub-region, as well as in other sub-regions/areas conditional to availability of data for the application of the NEAT GES assessment, while keeping the document open for the possible proposals for adjustment of the assessment results that might be received from the Contracting Parties no later than one month after this Meeting. The Secretariat indicated that this needs to be supplemented with related sound national justifications further to the comparison of the GES assessment results generated by the application of relevant national assessment methodologies and sub-regional application of NEAT GES assessment in the Adriatic Sea Sub-region as provided in this document.

52. Further to the potential proposals for adjustment of the assessment results that might be received from the CPs and taking into consideration the requests expressed during the present meeting, the Secretariat confirmed that the final update of the assessment findings as provided in the Meeting Document UNEP/MED WG.533/5 will precede their integration in the 2023 MED QSR. The final update will be undertaken by considering:

i. the final update of the assessment criteria for IMAP CI 17 as agreed in the Meeting document UNEP/MED WG.533/3;
ii. a possible use of lower boundary limit between moderate and poor classes; and
iii. reporting of new data in the IMAP Info System no later than by October 2022.

53. In line with the summary of the discussion provided by the Secretariat, the Meeting approved Working Document UNEP/MED WG.533/5 as revised during the Meeting in terms of applying the NEAT GES assessment methodology in the Adriatic Sea Sub-region, as well as in other sub-regions/sub-areas conditional to availability of data for application of the NEAT GES assessment. The Meeting recommended the submission of the document to the MED POL FPs Meeting, which will be held in May/June 2023 further to the revision of the assessment findings by the Secretariat, as appropriate.

54. The final conclusions and recommendations of the Meeting related to this agenda item are presented in Annex III, including Meeting Working Document UNEP/MED WG.533/5 and related Information Documents UNEP/MED WG.533/Inf.4 and UNEP/MED WG.533/Inf. 5, as revised and approved by the Meeting.

Agenda Item 5: GES Assessment for IMAP Common Indicator 17 in the Areas with Limited Data Availability

55. The UNEP/MAP Monitoring and Assessment Officer presented Working Document WG.533/6 on the methodology and the results of the CHASE+ methodology application for GES assessment of IMAP Common Indicator 17 in the Levantine Sea basin. She explained that the present document elaborates on the application of the CHASE+ (Chemical Status Assessment Tool) methodology for IMAP Common Indicator 17 and its comparison with the IMAP traffic light approach applied within the 2017 Mediterranean Quality Status Report. She indicated that it was applied following experience acquired on its application by the European Environmental Agency (EEA) to assess environmental status categories for the European Seas (Andersen et al. 2016, Anon 2019). The work was undertaken in line with the conclusions of the Meeting of CorMon on Pollution Monitoring (Teleconference, 26-27 April 2021) and the Meeting of the MED POL Focal Points (Resumed Session, 9 July 2021) related to the Working Document UNEP/MED WG.509/10/rev.2 "Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster". She noted that considering the rules for the integration and aggregation, the present application of CHASE+ methodology in the Levantine Sea basin was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, calculation of a contaminantion ratio (CR) and aggregation of measured concentrations of the contaminants to calculate a contamination score (CS), when possible, was undertaken. She explained that in order to avoid a bias in the Mediterranean regional assessment, the present work included inter-comparison of different approaches applied for setting GES and nonGES classes in the Adriatic Sea Sub-region and the Levantine basin. The stricter boundary limit between GES and non-GES status was applied in the Levantine Sea basin in order to compensate for the lack of data; and hence a less confident assessment. She indicated also that the CHASE + methodology compensates for the lack of applying spatial integration and aggregation as required for nesting of the assessment areas and assessment results within IMAP implementation that was applied in the Adriatic Sea Sub-region; adding that it has to be noted that the application of the NEAT methodology requires a larger quantum of data than available in the Levantine Sea Basin. She continued by elaborating on assessment findings provided for the Levantine Sea basin by applying the CHASE+, along with their comparison with the results based on traffic light comparison of measured concentrations and the assessment criteria. In conclusion, she expressed expectation that the present document will be approved by the Meeting in terms of the results of GES assessment findings as provided and further application of the CHASE+ methodology in the areas where it is impossible to undertake GES assessment methodologies based on IMAP nesting of the areas of assessment.

56. After the introductory elaboration, the Working document UNEP/MED WG.533/6 was placed on the screen for the consideration and comments of the participants.

57. One meeting participant referred to Table 1, asking for an explanation of the use of data from 2013 and 2014 given such old data might be irrelevant for the present assessment. He also asked for taking climate change impacts into consideration. In responding to this observation, the Secretariat explained that data of Cyprus related to Cd dated in 2013 and 2014 were analyzed but not used for the present assessment as all the points from Cyprus were above EAC, due to specific local mineralogy. Data related to Hg and Pb from 2013 and 2014 were also used along with data reported from 2015 to 2019 to increase the confidence in the assessment. The Secretariat noted also that Table 1 shows only the availability of data for the pilot application of proposed updated criteria for the environmental assessment of the Levantine Sea Basin, while Table 4 shows a number of data points and their percentage from the total number of data points that were used for application of CHASE+ and traffic light. The Secretariat indicated that in paragraph 19, there is a recommendation to check the high Pb concentrations against Al or Fe in the samples, as normalizers, in order to confirm or refute the traffic light-based classification. Data on Σ16 PAHs in sediment were available only for Israel dated back to 2013 and from Lebanon dating to 2019. Based on the foregoing, the Secretariat decided to use this one dataset from Israel to make some initial assessment findings. Based on this excercise, it was found that due to the limited data availability no conclusion could be provided on GES status at the level of the Levantine Sea Basin. The Secretariat concluded that given the present level of data reporting, it is impossible to include climate change impacts in the present GES assessment for IMAP CI 17.

58. One meeting participant questioned the proposal of decision rule according to which area or the stations is considered in GES status if 75% of the elements assessed are in GES. For example, in Spain, this rule is set at 95% of the elements that need to be in GES. He suggested that consideration is given to adjusting the presently proposed decision rule. In responding to this question, the Secretariat explained that one decision rule used is the “One out all out approach” (OOAO) which states 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. The Secretariat indicated that another 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. In the case of GES assessment in the Levantine Sea basin, it is recommended that if at least 75% of the elements are in GES, the station should be considered in GES. The same recommendation is given when assessing certain areas or the whole Levantine Sea Basin sub-division i.e., when 75% of the stations are in GES for a certain parameter, the whole sub-region is in GES. This more lenient approach for the GES-nonGES decision rule compensates for stricter thresholds applied within the CHASE+ methodology. The Secretariat noted that in the case of GES assessment using the NEAT tool in the Adriatic Sea Sub-region, the decision rule is related to the NEAT value. The NEAT value of a subSAU or SAU defines its GES class. The NEAT value is based on the average concentration of each contaminant (all stations - temporal data) in the finest subSAU normalized in a scale of 0 to 1. Values ≥0.6 are considered in GES, because the normalized GES-nonGES threshold value is always assigned as 0.6. The subsequent aggregation and integration process uses the respective NEAT values and averages in a weighted manner (when integrating at a higher level). During every step of the process, a NEAT value is calculated which defines the GES class either on a higher-level SAU or on the habitat level, see Tables 3 and 4. The decision rule for the NEAT tool is not based on a percentage of stations data falling above or below GES, but on the NEAT value as here explained, which allows for a more fine scaling /grading of the aggregated/integrated data within the nesting scheme. The Secretariat suggested and Meeting agreed on deciding on this rule application during the next Meeting of CorMon, given assessment results will be then also available in other areas.

59. He also asked for an explanation of how traffic light was applied. The Secretariat explained that measured concentrations were compared with the assessment criteria; therefore, without averaging of measured concentrations.

60. Another meeting participant asked for the inclusion of the correction in Tables A.2.1 and A.2.2 by adding the name Lebanon to those stations that belong to this country; as well as by writing the full name of Lebanon at a few places in these tables.

61. The Secretariat summarized the discussion and confirmed that further update of the assessment findings presented in the Working document UNEP/MED WG.533/6 will be undertaken when the Contracting Parties report new data in the IMAP Info System, by end of October 2022 at the latest, with a view of including generated GES assessment findings in the 2023 MED QSR.

62. In line with the summary of the discussions provided by the Secretariat, the Meeting approved Working Document UNEP/MED WG.533/6 as revised during the Meeting in terms of applying CHASE+ methodology in the Levantine Sea Basin, as well as in other sub-regions/sub-areas characterized by the lack of sufficient data for the application of the NEAT GES assessment within the preparation of the 2023 MED QSR. The Meeting recommended the submission of the document to the MED POL FPs Meeting, which will be held in May/June 2023 further to the revision of the assessment findings by the Secretariat, as appropriate.

63. The final conclusions and recommendations of the Meeting related to this agenda item are presented in Annex III, including Meeting documents UNEP/MED WG.533/6, as revised and approved by the Meeting.

Agenda Item 6: Initial Marine Environment Assessment for IMAP Common Indicator 21

64. The UNEP/MAP Monitoring and Assessment Officer presented Working Document WG.533/9 that provides the initial GES assessment for IMAP Common Indicator 20 with a view to providing inputs for the preparation of the 2023 MED QSR. She noted that assessment results are elaborated for the Mediterranean sub-regions respectively the Contracting Parties of the Barcelona Convention for

which sufficient data were available both in the IMAP Information System and the State of Bathing Water Quality in 2020 of the European Environment Agency (EEA). She also indicated that the assessment methodology defined in the IMAP Guidance factsheet for IMAP CI 21 is adjusted to data availability for the present assessment to include setting the boundary limit between GES and non-GES status regarding the pathogens in bathing waters. She expressed expectation that the present document will be approved by the Meeting with the understanding that the results of GES assessment for IMAP CI 21 might be further updated conditional to data reporting by the CPs. She invited the CPs to report sufficient data, i.e., 16 data points for 4 consecutive bathing seasons in order to ensure further progress in the preparation of the comprehensive and reliable final assessment input for the preparation of the 2023 MED QSR.

65. After the introductory elaboration, the Working document UNEP/MED WG.533/9 was placed on the screen and opened for discussion for the consideration and comments of the meeting participants.

66. The meeting participants did not suggest the inclusion of any revision point in the document. By acknowledging the results of the GES assessment for IMAP CI 21, the Meeting asked for an update of the assessment findings further to possible data reporting in the IMAP Info System no later than by October 2022.

67. The Meeting approved Working document UNEP/MED WG.533/9 in terms of applying the assessment approach based on a combination 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 CI 21 in the IMAP Info System and recommended its submission to the MED POL Focal Points Meeting to be held in May/June 2023.

68. The final conclusions and recommendations of the Meeting related to this agenda item are presented in Annex III, including Meeting documents UNEP/MED WG.533/9, as approved by the Meeting.

Agenda item 7: Data Standards and Data Dictionaries for IMAP Common Indicators 18 and 20

69. The UNEP/MAP Monitoring and Assessment Officer and Mr. Arthur Pasquale, Deputy Director of INFO/RAC presented Working Documents UNEP/MED WG.533/7 and UNEP/MED WG.533/8 providing Data Standards (DSs) and Data Dictionaries (DDs) for IMAP Common Indicators 18 and 20. First, the process of preparation of the documents, as well as their content, were explained. The upload of the DSs and DDs into IMAP (Pilot) Info System and the consequent changes to the data base structure was clarified in the context of expected data reporting by the Contracting Parties, noting that the present final proposals were elaborated based on the elements of Data Standards and Data Dictionaries for IMAP CIs 18 and 20 that were discussed during the Meeting of CorMon on Pollution (26 to 28 April 2021). The Secretariat explained that the proposal of the documents addressing the comments of CorMon was also presented for the information of the 8th Meeting of the Ecosystem Approach Coordination Group (9 September 2021). The present Meeting of CorMon on Pollution is expected to approve these final proposals of DDs and DSs for their integration into IMAP Info System with a view of receiving monitoring data from the Contracting Parties for the preparation of the 2023 MED QSR.

70. After the introductory elaboration, the Working documents UNEP/MED WG.533/7 and UNEP/MED WG.533/8 were respectively placed on the screen and opened for discussion for the consideration and comments of the participants.

71. One meeting participant explained that the two species *Mytilus galloprovincialis* and *Mullus barbatus,* considered mandatory in line with IMAP, are not monitored in Tunisia. He also asked whether they can be replaced by others and about the meaning of the mandatory status of species. In responding to this question, the Secretariat explained that the CPs can report data related to species other than two mandatory species; however, in line with the list of reference species provided in Table 3 that was approved for the IMAP CI 17 by the 7th Meeting of the Ecosystem Approach Coordination Group. The mandatory status indicates that the two species *Mytilus galloprovincialis* and *Mullus*

barbatus are agreed as priority common species for reporting monitoring data by the Contracting Parties. The initial phase of IMAP implementation confirms the necessity to consider adding other areas - specific mandatory species; however, related decision cannot be taken now, but later during expected IMAP revision after the 2023 MED QSR delivery.

72. Another meeting participant proposed changing the status of salinity and temperature so that they are considered mandatory parameters given their importance for monitoring of certain biomarkers. The participant also asked for changing the status of data on species gender to mandatory. This proposal was followed by a suggestion of another participant who asked for: i) changing the status of data on dissolved oxygen to mandatory; and ii) replacing “weight” with “somatic weight” in the cell “Specimen_weight”. These proposals were accepted by the Meeting, and proposed changes are included in Table 2 of the revised Meeting document UNEP/MED WG.533/7.

73. Another meeting participant took the floor asking to change the status of data on pressure type into non–mandatory in order to also include the reference sites where no pressure type is present. The Secretariat explained that the Meeting of CorMon on Pollution (26 to 28 April 2021) already agreed on keeping information related to the type of pressure in black; therefore, as mandatory. In that respect, it should be noted that the “pressure type” is aimed at providing information on the type of pressure if it exists; and if this is not the case, then any information should not be added to this cell. The Secretariat added that as another cell just above the one providing the pressure type refers to area typology; therefore, this allows to report on the status that corresponds to the reference site without any pressure.

74. One more proposal was suggested by a meeting participant to add an additional cell in Table 2 that is related to pooling. The proposal was accepted by the Meeting, and a new mandatory data is included in Table 2 of the revised Meeting document UNEP/MED WG.533/7.

75. Another meeting participant asked for the following changes in the cell “Biomarker_Unit”: i) to delete “nmol/min/mg protein in gills (bivalves)” from parenthesis; and ii) to delete units “µg/g = Metallothioneins level (MT) (µg/g digestive gland)” and “LT50 (days) = Stress on Stress (SoS)” given MT and SoS are non – mandatory biomarkers. These proposals were accepted by the Meeting, and proposed changes are included in Table 2 of the revised Meeting document UNEP/MED WG.533/7.

76. The meeting participant followed by proposing the following additions to be included in cell “Biomarker_Unit_NM”: i) explanation that the cell “Biomarker_Unit’ has to be filled in with ‘NM’ in case of EROD, SoS and MT, as additional non-mandatory biomarkers; ii) units “µg/g = Metallothioneins level (MT) (µg/g digestive gland)” and “LT50 (days) = Stress on Stress (SoS)” to be placed in this cell following up on their deletion from the cell “Biomarker_Unit”; and iii) unit “pmol/min/mg microsomal protein” needs to be added for EROD as a non-mandatory indicator. The proposals were accepted by the Meeting, and changes are included in Table 2 of the revised Meeting document UNEP/MED WG.533/7.

77. In line with the changes included in Table 2, the two meeting participants asked for the inclusion of the following amendments in Table 4: i) replacing “Fish” with “Mussel” as the organism that is used for monitoring of MN; and ii) adding Ethoxyresorufin-o-deethylase activity (EROD) as non–mandatory biomarker, along with an indication of fish as organism used for monitoring of this biomarker respectively liver as tissue.

78. Regarding the Meeting document UNEP/MED WG.533/8, one meeting participant expressed the opinion that it will be difficult to ensure reporting of all data as included in the DDs and DSs for IMAP CI 20. He asked for the synchronization of DDs and DSs with the EU Common Fisheries Policy. Another meeting participant expressed the opinion that greater flexibility should be ensured regarding data reporting for IMAP CI 20 by noting the lack of accredited laboratories in her country that could generate all mandatory data as required in this DDs and DSs. The Meeting participant suggested reducing number of the contaminants that are considered mandatory data. One more participant took the floor and asked for adding a new cell “Fat Content” in Table 2 along with the related description “Fat content as percentage of total wet matter” in order to harmonize this DDs and DSs for IMAP CI 20 with the existing one for CI 17.

79. In response to the above points, the Secretariat explained that the DDs and DSs for IMAP CI 20 are aligned with the regulatory levels for the contaminants regulated in the EU regarding the protection of human health as presented in EU Regulations (EC) No 1881/2006, (EC) No 835/2011 and EC No 1259/2011 (Annex III), adding that further synchronization with EU policies is not possible at this stage and that the concentration limits for the contaminants regulated in the EU, presented in a concise format in Annex I, have been considered for preparing this proposal of DDs and DSs for IMAP CI 20 in line with the conclusion of the Meeting of CorMon on Pollution Monitoring that was held from 26 to 28 April 2021. The Secretariat indicated that the list of contaminants includes Cd, Hg, Pb, four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene), dioxins, dioxin-like and non-dioxin-like PCBs (PCB 28, PCB 52, PCB 101, PCB 138, PCB 153 and PCB 180) and radionuclides; therefore, 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. In such a manner, consistency is ensured with EU Regulations and the list of contaminates as defined for IMAP CI 17.

80. Following up on the review and discussion of the Working Documents UNEP/MED WG.533/7 and UNEP/MED WG.533/8 , the Meeting approved the proposals of Data Standards and Data Dictionaries for IMAP CIs 18 and 20 for their integration into the IMAP Info System with a view to receiving monitoring data from the Contracting Parties no later than by October 2022 for preparation of the 2023 MED QSR.

81. The final conclusions and recommendations of the Meeting related to this agenda item are presented in Annex III, including Meeting documents UNEP/MED WG.533/7 and UNEP/MED WG.533/8, as revised and approved by the Meeting.

Agenda item 8: Any Other Business

82. Under this agenda item, Mr. Gabino Gonzalez, Head of Office, REMPEC, presented a progress regarding preparation of Data Dictionary for IMAP CI 19 and proposed a way forward. Following up on his presentation, the Meeting invited the Secretariat/REMPEC to continue its effort toward completion of a proposal for the Data Dictionary for CI 19.

Agenda item 9: Conclusions and Recommendations

83. The Meeting reviewed, commented on, and approved the draft Conclusions and Recommendations as attached to the present report as Annex III. This includes final refinements to ensure full consistency between the English and French versions.

Agenda item 10: Closure of the Meeting

84. After expressing the usual courtesies, the Chair declared the Meeting closed at 18:10 pm on Monday 30 May 2022.

Annex I
List of Participants

REPRESENTATIVES OF THE CONTRACTING PARTIES / REPRESENTANTS DES PARTIES CONTRACTANTES

ALGERIA	**Mr. Ahmed Inal** National center for research and development of fisheries and aquaculture, Tipaza
BOSNIA AND HERZEGOVINA / BOSNIE HERZEGOVINE	**Ms. Selma Cengic** Executive Director, Hydro-Engineering Institute (HEIS), Sarajevo **Ms. Senida Dzajic - Rghei, HEIS**
CROATIA /CROATIE	**Jelena Lusic**, Institute of Oceanography and Fisheries, Split **Ms. Slavica Matijević**, Scientific advisor Institute of Oceanography and Fisheries, Split
CYPRUS /CHYPRE	**Mr. Konstantinos Antoniadis** Department of Fisheries and Marine Research, Lefkosia
GREECE /GRECE	**Ms. Maria Gkin**i, Director Ministry of Environment and Energy, Athens
ISRAEL /ISRAEL	**Mr. Dror Zurel** Israel Ministry of Environmental Protection, Haifa **Mr Barak Herut** Director Israel Oceanographic and Limnological Research Institute (IOLR)
ITALY /ITALIE	**Ms. Daniela Berto** Ispra, Chioggia (venezia) **Ms. Ginevra Moltedo** Bioologist Researcher, Ispra, Rome
LEBANON / LIBAN	**Mr. Milad Fakri** Director & Research Director, National Council for Scientific Research, Jounieh **Ms. Celine Mahfouz**, National Centre for Marine Sciences, National Council for Scientific Research, Beirut
MALTA /MALTE	**Ms. Roberta Debono** Environment Protection Officer, Environment & Resources Authority, Marsa **Ms. Tamara Micallef** Senior Officer Thematic Environment and Resources Authority,

MONTENEGRO / MONTENEGRO	**Ms. Ivana Stojanovic** Head of Division, Ministry of Ecology, Spatial Planning and Urbanism
MOROCCO /MONACO	**Ms. Khadija Rhayou**r Ministère de l'environnement / laboratoire national, Rabat **Mr. Mohammed EL Bouch** Directeur, Département du Développement Durable, Rabat **Mr. Abdeslam Abid** Department of Sustainable Development (DDD/MTEDD), Rabat
SLOVENIA /SLOVENIE	**Ms Elizabeta Gabrijelcic** Slovenian Environment Agency, Ljubljana **Ms. Mateja Poje** Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Ljubljana
SPAIN /ESPAGNE	**Ms. Candela García Gómez** Instituto Español de Oceanografía (IEO), CSIC, Málaga (Murcia) **Ms. Nerea.Valcarcel** **I**nstituto Español de Oceanografía (IEO), CSI, Málaga (Murcia) **Mr. Víctor M. León** Instituto Español de Oceanografía (IEO), CSIC, San Pedro Del Pinatar (Murcia) **Ms. Concepción Martínez-Gómez** Instituto Español de Oceanografía (IEO), CSIC, San Pedro Del Pinatar (Murcia)
TUNISIA / TUNISIE	**Mr. Mohamed Sghaier Ben Jeddou**, Ministry For Environnement Of Tunisia, Tunis Tel : 0021698577699 **Mr. Lassaad Chouba**, Institut National des Sciences et Technologies de la Mer, INSTM, Salammbô **Mme. Afef Fathalli** Researcher, National Institute of Marine Sciences and Technologies, **Mme. Inès Houarbi Ben Sala**h Expert contrôleur en chef, Otedd/anpe, Tunis **Mr. Yassine Marzougui** MedPol National Focal Point, Agence Nationale de Protection de l’environnement, Tunis

TÜRKIYE / TÜRKIYE	**Mr. Mehmet Tamer ÇobanoĞlu** Expert, Ministry of environment, urbanisation and climate change, Ankara **Ms. Betül Keskin Çatal**, Senior Expert Ministry of Environment, Urbanization and Climate Change, Ankara **Ms. Ebru Olgun Eker**, Ministry of Environment, Urbanization and Climate Change, Ankara **Mme. Asli Topalak** Ministry of Environment and Urbanization, Ankara

REPRESENTATIVES OF OTHER INTERGOVERNMENTAL ORGANIZATIONS / REPRESENTANTS DES INSTITUTIONS SPECIALISEES DES NATIONS UNIES ET AUTRES ORGANISATIONS INTERGOUVERNEMENTALES

EUROPEAN ENVIRONMENT AGENCY / AGENCE EUROPEENNE POUR L'ENVIRONNEMENT	**Mr. Mustafa Aydın** Zero Pollution Expert, Copenhagen
UNION FOR THE MEDITERRANEAN SECRETARIAT / UNION POUR LA MEDITERRANE	**Ms. Cristina Cardenete Suriol**
IAEA/AIEA INTERNATIONAL ATOMIC ENERGY AGENCY / AGENCE INTERNATIONAL DE L'ENERGIE ATOMIQUE	**Ms. Emiliya Vasileva,** Research Scientist, Acting Section Head **Ms. Imma Tolosa** Research Scientist, Monaco **Experts** **Mr. Michail Angelidis** University of the Aegean, Greece **Mr. Aldo Viarengo** Scientist

NON-GOVERNMENTAL ORGANIZATIONS
ORGANISATIONS NON-GOUVERNEMENTALES

CENTRE INTERNATIONAL DE DROIT COMPARE DE L'ENVIRONNEMENT (CIDCE)	**M. Yoann Coulmont** **Ms Josiane Yazbeck**
CENTER FOR ENERGY, ENVIRONMENT AND RESOURCES	**Ms. Nadira Berbic** Project Manager
ECAT TIRANA	**Ms. Marjeta Mima** Director, Tirana
OGS	**Ms Megan Anne French**

UNITED NATIONS ENVIRONMENT PROGRAMME - COORDINATING UNIT AND COMPONENTS OF THE MEDITERRANEAN ACTION PLAN
PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT - UNITÉ DE COORDINATION ET COMPOSANTES DU PLAN D'ACTION POUR LA MÉDITERRANÉE

UNEP/MAP COORDINATING UNIT **PNUE/PAM UNITÉ DE COORDINATION**	**Mr. Mohamad Kayyal** Programme Management Officer E-mail: mohamad.kayyal@un.org **Ms. Jelena Knezevic** Monitoring and Assessment Officer E-mail: jelena.knezevic@un.org **Mr . Christos Ioakeimidis** Associate Project Management Officer E-mail: christos.ioakeimidis@un.org **Mr. Erol Cavus,** MED POL Pollution Control Officer E-mail: erol.cavus@un.org **Ms. Joanne Foden** QSR Management Officer E-mail: joanne.foden@un.org **Mr. Philippe Théou,** IMAP-MPA Project Manager E-mail: philippe.theou@un.org **<u>Experts</u>** **Ms. Nurit Kress** E-mail: nurit@ocean.org.il **Mr. Robert Precali** E-mail: rprecali@gmail.com
REGIONAL ACTIVITY CENTRE FOR INFORMATION AND COMMUNICATION (INFO/RAC) / CENTRE D'ACTIVITES REGIONALES POUR L'INFORMATION ET LA COMMUNICATION (CAR/INFO)	**Mr. Arthur Pasquale** Deputy Director E-mail: arthur.pasquale@isprambiente.it **Ms. Francesca Catini**
REGIONAL ACTIVITY CENTER FOR THE PRIORITY ACTIONS PROGRAMME (PAP/RAC) / CENTRE D'ACTIVITÉS RÉGIONALES PROGRAMME D'ACTIONS PRIORITAIRES (CAR/PAP)	**Mr. Marko Prem** Deputy Director E-mail: marko.prem@paprac.org **Mr. Ivan Sekovski** Programme Officer E-mail: ivan.sekovski@paprac.org

PLAN BLEU REGIONAL ACTIVITY CENTRE (PLAN BLEU/RAC) **PLAN BLEU, CENTRE D'ACTIVITÉS RÉGIONALES (PLAN BLEU/RAC)**	**Mr. Antoine Lafitte** E-mail: alafitte@planbleu.org
REGIONAL MARINE POLLUTION EMERGENCY RESPONSE CENTRE FOR THE MEDITERRANEAN SEA (REMPEC) / CENTRE **REGIONAL MEDITERRANEEN POUR L'INTERVENTION D'URGENCE CONTRE LA POLLUTION MARINE ACCIDENTELLE (REMPEC)**	**Mr Gabino Gonzalez Deogracia** Director E-mail : ggonzalez@rempec.org
REGIONAL ACTIVITY CENTER FOR SPECIALLY PROTECTED AREAS (SPA/RAC) / **CENTRE D'ACTIVITÉS RÉGIONALES POUR LES AIRES SPECIALEMENT PROTÉGÉES (CAR/ASP)**	**Mr Khalil Attia** E-mail: director@spa-rac.org **Mr Mehdi Aissi** Project Officer- IMAP-MPA (IMAP component) E-mail: mehdi.aissi@spa-rac.org

Annex II
Agenda of the Meeting

Provisional Agenda

Agenda Item 1:	Opening of the Meeting
Agenda Item 2:	Organizational Matters
Agenda Item 3:	Assessment Criteria
Agenda item 4:	GES Assessment for IMAP Common Indicator 17 based on the Application of the NEAT Tool in the Adriatic Sea Sub-region
Agenda item 5:	GES Assessment for IMAP Common Indicator 17 in the Areas with Limited Data Availability
Agenda item 6:	Initial Marine Environment Assessment for IMAP Common Indicator 21
Agenda Item 7:	Data Standards and Data Dictionaries for IMAP Common Indicators 18 and 20
Agenda Item 8:	Any Other Business
Agenda Item 9:	Conclusions and Recommendations
Agenda Item 10:	Closure of the Meeting

Annex III
Conclusions and Recommendations

Conclusions and Recommendations

On 27 and 30 May 2022, the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring was held by videoconference. The meeting was organized by UNEP/MAP Secretariat (MED POL Programme).

The Secretariat presented an overview of the working documents of this meeting that included the proposal of the adjusted Background (Assessment) Concentrations (BC/BAC) for Common Indicator 17 and upgraded Approach for Environmental Assessment Criteria (EAC) for IMAP Common Indicators 17, 18 and 20; assessment criteria methodologies for IMAP Common Indicator 13: reference and boundary values for DIN and TP in the Adriatic Sea Sub-region; the methodology and the results of the NEAT Tool application for GES assessment of IMAP Common Indicator 17 in the Adriatic Sea Sub-region; the pilot example for marine environment assessment in the areas with insufficient data i.e., the results of GES Assessment for IMAP Common Indicator 17 in the Levantine Sea Basin; the initial results of marine environment assessment for IMAP Common Indicator 21 and the Data Standards and Data Dictionaries for IMAP Common Indicators 18 and 20.

Following the review and discussions of all agenda items, the following conclusions were reached:

1. The Meeting appreciated the work undertaken and documents prepared by UNEP/MAP Secretariat/MED POL Programme, and acknowledged the progress achieved in the implementation of the Integrated Monitoring and Assessment Cluster in order to contribute to the successful delivery of the MED QSR 2023.

2. The Meeting called upon all Contracting Parties to make all possible efforts to improve the submission of their data in the IMAP Info System no later than October 2022; therefore, responding to the data call issued by the Secretariat in June 2020, in line with the agreed timeline.

Agenda item 3: Assessment Criteria

3. Following the review and discussion of Working Document UNEP/MED WG.533/3 “Adjusted Background (Assessment) Concentrations (BC/BAC) for Common Indicator 17 and Upgraded Approach for Environmental Assessment Criteria (EAC) for IMAP Common Indicators 17, 18 and 20,” and considering supplementary information provided by several participants, the Meeting approved Working Document UNEP/MED WG.533/3, revised and attached to these conclusions, in terms of using (a) 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) the approaches proposed for future upgrades of EAC values for IMAP Common Indicators 17, 18 and 20 that will take place as of 2024. The Meeting 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.

4. The Meeting recommended to MED POL FPs Meeting which will be held in 2023 to take note of the values of upgraded assessment criteria for IMAP Common Indicators 17 and 20, as agreed by the present Meeting of CORMON Pollution, with a view of their use for GES assessment in the different contexts that exist in the Mediterranean.

5. Following the review and discussion of Working Document UNEP/MED WG.533/4 “Assessment Criteria Methodologies for IMAP Common Indicator 13: Reference and Boundary Values for DIN and TP in the Adriatic Sea Sub-region,” and considering supplementary information provided by several participants, the meeting approved Working Document UNEP/MED WG.533/4, revised and attached to these conclusions, 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). 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. Due to limited data availability and related demanding statistics, the Meeting took note of the fact that the present upgrade of the assessment criteria related to IMAP Common Indicators 13 and 14 was possible for the Adriatic Sea Sub-region coastal and open (offshore) waters only.

6. The Meeting recommended to MED POL FPs Meeting, which will be held in 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.

Agenda item 4: GES Assessment for IMAP Common Indicator 17 based on the Application of the NEAT Tool in the Adriatic Sea Sub-region

7. Following the review and discussion of Working Document UNEP/MED WG.533/5 "The Methodology and the Results of the NEAT Tool Application for GES assessment of IMAP Common Indicator 17 in the Adriatic Sea Sub-region," and considering supplementary information provided by several participants, the Meeting approved Working Document UNEP/MED WG.533/5, revised and attached to these conclusions, in terms of applying the NEAT GES assessment methodology in the Adriatic Sea Sub-region, as well as in other sub-regions/sub-areas conditional to availability of data for application of the NEAT GES assessment, in line with a sound science-policy interface within the preparation of the 2023 MED QSR as requested by Decisions IG.23/6 (COP 20) and IG.24/4 (COP 21).

8. The Meeting requested the Secretariat/MED POL to undertake final update of the assessment findings as provided in the Meeting document UNEP/MED WG.533/5 in line with the following:

i. the final update of the assessment criteria for IMAP CI 17 as agreed in the Meeting document UNEP/MED WG.533/3;
ii. a possible use of lower boundary limit between moderate and poor classes;
iii. reporting of new data in the IMAP Info System no later than by October 2022.

9. The possible proposals for adjustment of the assessment results as presented in the Meeting document UNEP/MED WG.533/5 can be submitted to the Secretariat not later than one month after this Meeting. This needs to be supplemented with related sound national justifications further to the comparison of the GES assessment results generated by the application of relevant national assessment methodologies and sub-regional application of NEAT GES assessment in the Adriatic Sea Sub-region as provided in this document. The Meeting recommended to MED POL FPs Meeting, which will be held in 2023, to take note of the assessment findings that will be revised by the Secretariat as appropriate.

Agenda Item 5: GES Assessment for IMAP Common Indicator 17 in the Areas with Limited Data Availability

10. Following the review and discussion of Working Document UNEP/MED WG.533/6 "The pilot example for Marine Environment Assessment in the Areas with Insufficient Data: The Results of GES Assessment for IMAP Common Indicator 17 in the Levantine Sea Basin," and considering correction provided by one participant, the Meeting approved the Working Document UNEP/MED WG.533/6, attached to these conclusions, in terms of applying $CHASE^{+}$ methodology in the Levantine Sea Basin, as well as in other sub-regions/sub-areas characterized by the lack of sufficient data for application of the NEAT GES assessment with a view of preparation of the 2023 MED QSR.

11. The Meeting recommended to MED POL FPs Meeting, which will be held in 2023, to take note, of the final CHASE+ assessment findings for the Levantine Sea Basin within Aegean Levantine Sub-region based on the assessment findings as presented in the Meeting document UENP/MED WG.533/6 and further updates conditional of reporting new data in the IMAP Info System no later than by October 2022, as appropriate, with a view of such generated GES assessment findings in the 2023 MED QSR.

Agenda Item 6:
Initial Marine Environment Assessment for IMAP Common Indicator 21

12. Following the review and discussion of Working Document UNEP/MED WG.533/9 “The Initial Results of Marine Environment Assessment for IMAP Common Indicator 21,” and with a view of preparation of the 2023 MED QSR, the Meeting approved the Working Document UNEP/MED WG.533/9 in terms of applying the assessment approach that is based on combination 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 CI 21 in the IMAP Info System.

13. The Meeting acknowledged the results of the GES assessment for IMAP CI 21 in the Mediterranean, as presented in the Working Document UNEP/MED WG.533/9, asking the Secretariat/MED POL to undertake their update further to possible data reporting in the IMAP Info System no later than by October 2022.

14. The Meeting recommended to MED POL FPs Meeting, which will be held in 2023, to take note of the final assessment findings for IMAP CI 21 in the Mediterranean with a view of their integration in the 2023 MED QSR.

Agenda Item 7: Data Standards and Data Dictionaries for IMAP Common Indicators 18 and 20

15. The Meeting reviewed the Working Documents UNEP/MED WG.533/7 “Data Standards and Data Dictionaries for IMAP Common Indicator 18” and UNEP/MED WG.533/8 “Data Standards and Data Dictionaries for IMAP Common Indicator 20” prepared at the request of the Meeting of CorMon on Pollution Monitoring (26 to 28 April 2021). After inclusion of supplementary information and addressing the inputs provided by the participants, the Meeting approved the proposals of Data Standards and Data Dictionaries for IMAP CIs 18 and 20 for their integration into the IMAP Info System with a view to receiving monitoring data from the Contracting Parties no later than by October 2022 for preparation of the 2023 MED QSR.

Appendix 1

Adjusted Background (Assessment) Concentrations (BC/BAC) for Common Indicator 17 and Upgraded Approach for Environmental Assessment Criteria (EAC) for IMAP Common Indicators 17, 18 and 20

1 Introduction

1. This revised document updates the original document (UNEP/MED WG.492/12 Rev.2) presented at the Meeting of CorMon on Pollution Monitoring that took place on 26-28 April 2021. It includes a recalculation of the new proposed BCs and BACs concentrations using data that were not available at the time the document was prepared, namely, data received from February 2021 to December 2021. This revised document incorporates also the comments received during the Meeting of CorMon on Pollution Monitoring that took place on 26-28 April 2021; the resuming session of the Meeting of MEDPOL Focal Points that was held on 9 July 2021; and the 8th EcAp Coordination Group Meeting held on 9 September 2021. It also addresses the findings and comments received from members of the OWG (Online Working Group) on Contaminants during the virtual meeting that took place on June 18th, 2021 and in subsequent e-mail consultations.

2. The criteria established by Decisions IG.22/7 (COP 19)[1] and IG. 23/6 (COP 20)[2] are reviewed in Section 2 of present document, whereas Section 3 provides an in-depth analysis of the data available for present upgrade of the assessment criteria. New upgraded regional and sub-regional Mediterranean BC and BAC values for CI17, as well as a proposal of the criteria for IMAP CI20 are presented in Section 4. This section also proposes an approach to upgrade the Mediterranean EACs.

3. The data used for developing updated assessment criteria were collected in the IMAP Pilot Info System during its testing phase, and in particular after launching a formal call for reporting of monitoring data in June 2020, as well as monitoring data stored in MEDPOL database that have not been previously used for calculation of the assessment criteria applied in the 2017 and 2019 assessments, and data since 2015 even if previously used, following the recommendations of OWG on Contaminants. It also took into account data from EU data center (European Marine Observation and Data Network - EMODnet), as a reliable external data source, as well as data collected from the scientific literature. A detailed compilation of the available new data is given in Section 3.

2 The assessment criteria for IMAP Common Indicators 17 and 18

4. Deriving and setting up criteria to determine environmental status is not an easy task. It gets more complicated going from the local to sub-regional and regional assessments. While there are many methodologies to derive criteria, the first step is aimed at defining the background or reference conditions from which to measure/determine the status and trends. In the framework of UNEP/MAP (UNEP/MAP 2016, 2019), the background concentration (BC) is defined as “The concentration of a contaminant at a “pristine” or “remote” site based on contemporary or historical data”. The BC of anthropogenic (man-made) substance was defined as zero.-The same definitions are used by OSPAR and the Marine Strategy Framework Directive (MSFD) based on the Water Framework Directive (WFD) (Tornero et al. 2019).[3]

5. In line with these definitions, the BC determination is the first step of the derivation of indicators that are defined as the measure, index or model used to estimate the current state and future trends, along with thresholds for possible management action.

2.1 Methodology for background concentration (BC) determination

6. Several methods can be used to derive BC values for natural occurring elements/substances in different environmental matrices (i.e. sediment and biota).[4.] Briefly, they include using global average concentrations; pre-industrial age data; current data from pristine sites; data from monitoring programmes, whereas known polluted sites are excluded.

[1] UNEP/MAP (2015). Decision IG.22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (Annex II), (COP 19, 2015).
[2] UNEP/MAP (2017). Decision IG.23/6 on Mediterranean Quality Status Report (COP20, 2017).
[3]Additional definitions for BC can be found in the literature and are explained in UNEP/MED WG.533/Inf.3 submitted for information to present meeting.
[4] See document UNEP/MED WG. 533/Inf.3.

2.2 The methodology for the determination of Background concentration (BC) used by UNEP/MAP

7. The BCs were derived using the following two methodologies: i) data from sediment cores compiled from the scientific literature (UNEP/MAP 2011)[5] and ii) data from the MEDPOL database (UNEP/MAP 2011, 2016, 2019). A complete explanation of the used methodologies is given in these documents, as well as in UNEP/MED WG 533/Inf.3, submitted for consideration of present Meeting. The specific methodologies used by UNEP/MAP for the different parameters are described in sections 2.2.1-2.2.4.

2.2.1 Trace Metals (Cd, Hg and Pb) in sediments

8. The approved BCs for Trace Metals (TM) in sediments are summarized in Table 1. Briefly, in 2016, the first step was to choose the stations to be considered as reference at a country level. For each country, each parameter was grouped by year and the years without temporal trend chosen. Next, the parameters were grouped by stations and the overall median value computed. Stations where the 75th percentile of the data were below the overall median were chosen as reference stations.[6] Data of the reference stations were aggregated for the whole Mediterranean Sea and the MedBC computed as the median value of all reference stations. In 2019, BC values were computed in a similar way for 3 out of the 4 Mediterranean sub-regions[7]: Western Mediterranean (WMS), Adriatic Sea (ADR) and Aegean-Levantine Seas (AEL)[8]. No data were available to calculate BC for the Central Mediterranean (CEN). It was recommended to normalize the concentrations to Al (5%) concentrations[9].

Table 1. Background concentrations (BC) and Background assessment concentrations (BAC) calculated for trace metals (TM) in sediments for the Mediterranean Sea and sub-regions in 2011 and 2019. The table also presents the MedBAC and MedEAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in µg/kg dry wt, as requested by IMAP[10].

TM	Decisions IG.22/7 and IG.23/6 (COP 19 and COP 20)			UNEP/MAP (2011)		UNEP/MAP (2019)			
	MedBAC	MedBAC	MedEAC*	Med BC	Med BC	Med BC	BC	BC	BC
	IG.22/7	IG.23/6	IG.23/6	Sed cores	Surf Sed	Ref Stn	WMS	ADR	AEL
Cd	150	127.5	1200	100	20	85	91.2	92.3	56
Hg	45	79.5	150	30	10	53	60	106.8	31.2
Pb	30000	25425	46700	20000	2310	16950	20465	13932	4920

[5] For the purpose of this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes.
[6] In OSPAR`s methodology, the stations where the 95th percentile of the data were below the overall median were chosen as reference stations. It should be noted that this value can be very lenient concerning the environment.
[7] Although sub-regional values for the BCs in sediment were proposed, an updated 2019 assessment used the ones calculated in 2016, awaiting further confirmation of sub-regional values when new reference datasets will be available, whilst for mussels the proposed sub-regional values of BCs were exercised.
[8] The Mediterranean sub-regions and subareas are initially proposed according to availability of database sources for calculation of the assessment criteria (UNEP(DEPI)/MED WG.427/Inf.3; UNEP/MED WG.463/8; UNEP/MED WG.467/7).
[9] Normalization should be used with care, and only if field data support that normalization is valid for the area. An explanation on normalization practice for monitoring of IMAP Common Indicator 17 is provided in Monitoring (Guidelines/Protocols for Sample Preparation and Analysis for sediments (UNEP/MAP WG.482/12) and biota (UNEP/MAP WG.482/14)). In this document, data used for calculation of BC values were not normalized, since there were no available data on normalizers (i.e. Al, total organic carbon (TOC)) in the data sets reported by the Contracting Parties. The same is true for the data sets used for an upgrade of the assessment criteria applied in the 2017 and 2019 assessments.
[10] UNEP/MED WG.467/5. IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21: New proposal for candidate indicators 26 and 27; UNEP/MED WG.467/8. Data Standards and Data Dictionaries for Common Indicators related to Pollution and Marine Litter.

* ERL (Effects Range Low, Long et al. 1995, idem OSPAR values). Sediment (Sed); Surficial (Surf); Reference stations (Ref Stn); Western Mediterranean (WMS); Adriatic (ADR) Aegean; Levantine Sea (AEL). No data were available to set up BCs for the Central Mediterranean (CEN).

9. Further to this work, present document (Section 4) provides updated BC and BAC values for TM in sediments. They were calculated by using the new data and the same methodologies as applied in 2016 and 2019.

2.2.2 Naturally occurring organic compounds (PAHs) in sediment

10. MedBC values for PAHs in sediments are summarized in Table 2. The BCs were computed based on data derived from sediment cores compiled from the scientific literature, as well as data available in MEDPOL database (UNEP/MAP 2011). Normalization of organic compounds concentrations to total organic carbon (TOC) (2.5%) was recommended (See Section 2.2.5, UNEP/MED WG.533/Inf.3). However, the multiplication factor was not provided for calculation of BACs for PAHs in sediments in the previous UNEP/MAP documents (2011, 2016, 2019). The value of multiplication factor is proposed for present calculation as provided in Table 10 (see section 4.1 of UNEP/MED WG.533/Inf.3), looking at the OSPAR values for BC and BAC for PAHs in the sediments and considering now calculated relatively higher values of BCs for PAHs in sediments in comparison to the BCs calculated in 2011.

Table 2. Background concentrations (BC) calculated for PAHs in sediments for the Mediterranean Sea in 2011. The table also presents the MedEAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in µg/kg dry wt, as requested by IMAP.

PAH compounds	Decisions (COP 19 and COP 20)	UNEP/MAP (2011)	
	EAC* IG.22/7 and IG.23/6	BC Sed cores	BC Sur sed
Naphthalene (N)		4	
Acenaphthylene (ACY)		0.5	1.05
Acenaphthene (ACE)		0.38	0.45
Fluorene (F)		0.75	0.33
Phenanthrene (P)	240	4.55	3.95
Anthracene (A)	85	0.8	1.56
Fluoranthene (FL)	600	5.6	6.7
Pyrene (PY)	660[11]	10.28	2.1
Benzo[a]anthracene (BaA)	261	3.45	1.28
Chrysene (C)	384	1.3	6.64
Benzo(b)fluoranthene (BbF)		1.1	8.32
Benzo(k)fluoranthene (BkF)		0.53	6.03
Benzo[a]pyrene (BaP)	430	2.55	3.71
Benzo[g,h,i]perylene (GHI)	85[12]	1.25	3.25
Dibenz [a,h]anthracene (DA)	[13]	0.18	1.37
Indeno[1,2,3-c,d]pyrene (ID)	240[14]	1.7	4.49

* ERL. ERL for Naphthalene (160 µg/kg dw) and Total PAHs (4022 µg/kg dw) were derived by Long et al., 1995, but they do not appear in the COPs decisions.

11. Further to this work, present document (Section 4; UNEP/MED WG.533/Inf.3) provides updated BC and BAC values for PAHs in sediment. They were calculated by using the new data and the same methodologies as applied in 2016 and 2019 for trace metals.

[11] Updated value in IG. 23/6 of the value of 665 as provided in in IG.22/7
[12] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring
[13] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring
[14] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring

2.2.3 Naturally occurring trace metals (Cd, Hg and Pb) and organic compounds (PAHs) in biota[15]

12. Unlike the sediments, there are no values of the pristine, pre-industrial concentrations of naturally occurring compounds in biota. In 2011, the BC concentrations were computed based on the whole MEDPOL database (excluding known polluted stations), as the median of the lower 5% of the data. In 2016 and 2019, the BC concentrations were computed as for trace metals in sediments, based on the data sets from the selected reference stations. The calculated BC values for TM are presented in Table 3 for mussel and fish. The calculated BCs for PAHs in mussel are presented in Table 4. It should be emphasized that BC concentrations are species specific as well as tissue specific (i.e. natural concentrations in muscle are different from the natural concentrations in liver). In addition, BC concentration may depend on age of the specimens, with length and weight usually used as a proxy to age[16].

Table 3. Background concentrations (BC) calculated for trace metals in mussel and fish for the Mediterranean Sea and sub-regions in 2016 and 2019. The table also present the MedBAC and MedEAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in the units requested by IMAP.

TM	Decisions (COP 19 and COP 20)			UNEP/MAP (2019)			
	MedBAC IG.22/7	MedBAC IG.23/6	#MedEAC IG.23/6	BC Med	BC WMS	BC ADR	BC AEL
Mussel soft tissue (*Mytilus galloprovincialis*), µg/kg dry wt							
Cd	1088	1095	5000	730	660.5	782	942
Hg	188	173.2	2500	115.5	109.4	126	110
Pb	3800	2313	7500	1542	1585	1381	2300
Fish muscle (*Mullus barbatus*) µg/kg wet wt							
Cd	16**	*3.7	50	*3.7			
Hg	600**	101.2	1000	50.6	68	150.5	44.6
Pb	559[17]**	*31	300	*31	38		20

* Most values below detection limit, ** Concentrations in µg/kg dry wt as given in Decision IG. 22/7. # EACs are the ECs, the maximum levels for certain contaminants in foodstuffs based on European policy (EC/EU 1881/2006, 1259/2011 Directives and amendments 488/2014 and 1005/2015). Western Mediterranean (WMS); Adriatic (ADR) Aegean; Levantine Sea (AEL). No data were available to set up BCs for the Central Mediterranean (CEN)

Table 4. Background concentrations (BC) calculated for PAHs in mussel (*Mytilus galloprovincialis*) soft tissue for the Mediterranean Sea and sub-regions in 2016 and 2019. The table also present the MedBAC and EAC values agreed upon in Decisions IG.22/7 and IG.23/6. Concentrations are given in µg/kg dry wt, as requested by IMAP.

PAH compounds	Decisions (COP 19 and COP 20)		UNEP/MAP (2019)			
	MedBAC IG.23/6	EAC* IG.22/7 and IG.23/6	BC Med	BC WMS	BC ADR	BC AEL
Naphthalene			(2.4) #	2.24		2.80
Acenaphthylene			(0.6) #			
Acenaphthene			(0.6) #			
Fluorene	2.5		1.0	0.96	1.07	0.60
Phenanthrene	17.8	1700	7.1	4.93	9.04	7.55
Anthracene	1.2	290	0.5	0.52	0.38	0.30
Fluoranthene	7.4	110	3.0	3.38	2.03	6.60
Pyrene	5.0	100	2.0	3.02	0.85	5.90

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[15] The mussel *Mytilus galloprovincialis* (MG) and the fish *Mullus barbatus* (MB), the agreed mandatory species for monitoring
[16] See document UNEP/MED WG.533/Inf.3
[17] Correction introduced to correct technical error in document presented to the Meeting of CorMon on Pollution Monitoring

PAH compounds	Decisions (COP 19 and COP 20)		UNEP/MAP (2019)			
	MedBAC	EAC*	BC	BC	BC	BC
	IG.23/6	IG.22/7 and IG.23/6	Med	WMS	ADR	AEL
Benzo[a]anthracene	1.9	80	0.8	1.20	0.53	1.60
Chrysene	2.4		1.0	1.24	0.27	5.20
Benzo(b)fluoranthene						
Benzo(k)fluoranthene	1.4	260	0.6	1.27	0.29	1.50
Benzo[a]pyrene	1.2	600	0.5	0.60	0.32	0.70
Benzo[g,h,i]perylene	2.3	110	0.9	0.90		1.20
Dibenz [a,h]anthracene	1.3		0.5	0.53		
Indeno[1,2,3-c,d]pyrene	2.9		1.2	1.23		0.90

* EC, maximum levels for certain contaminants in foodstuffs based on European policy (EC/EU 1881/2006, 1259/2011 Directives and amendments 488/2014 and 1005/2015). # most data below detection limit. In red, sub-regional BC values higher than MedBAC (MedBAC= 1.5 MedBC, see Section 2.3.1)

13. Further to this work, present document (Section 4; UNEP/MED WG.533/Inf.3) provides updated BC and BAC values for TM in biota and PAHs in mussel. They were calculated using the new data and the same methodologies as applied in 2016 and 2019.

2.2.4 Synthetic substances (non-naturally occurring) in sediments and biota

14. The BC of any anthropogenic (man-made) substance is defined as zero. However, analytically, it is impossible to measure a concentration that equals zero[18]. Therefore, the assessment of enrichment or bias from BC (zero) should consider the analytical limitations and methodological uncertainties. determination is based Hence it is to apply the lowest analytical threshold and define it as BAC solely for such anthropogenic substances. The BACs used here (paragraph 44, Table 13) for organochlorides is therefore based on the detection limits of the methods used and its uncertainty (precision and accuracy), as determined from CRMs (Certified reference materials) and proficiency testing. IMAP addresses organochlorinated contaminants (PCBs and pesticides) as detailed in Table 5. This table summarizes the EAC values for the Mediterranean, agreed upon in Decisions IG.22/7 (COP19) and IG.23/6 (COP20). No BC nor LC (Low concentrations) were calculated for the Mediterranean in 2016 nor in 2019 (UNEP/MAP, 2016, 2019).

Table 5. EAC values for organochlorinated contaminants in sediments, in mussel (*Mytilus galloprovincialis*) soft tissue and muscle tissue in fish (*Mullus barbatus*) for use in the Mediterranean Sea. The values were agreed upon in Decisions IG.22/7 and IG.23/6 and follow OSPAR's recommendations. Concentrations are given in the units requested by IMAP.

	Sediments		Mussel	Fish
	EAC* IG.22/7(µg/kg dw)	MedEAC* IG.23/6(µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg lipid)
PCBs				
CB28		1.7	3.2	64
CB52		2.7	5.4	108
CB101		3	6	120
CB118		0.6	1.2	24
CB138		7.9	15.8	316
CB153		40	80	1600
CB180		12	24	480

[18] The BCs for man-made substances should be regarded as zero, and therefore, the so-called low concentrations (LCs) might be used instead to derive assessment criteria. The latter could be derived from reliable datasets of analytical variability information reported from either certified reference materials (CRMs) or independent proficiency testing (PTs) scheme databases. However, the Contracting Parties of Barcelona Convention agreed to use the BC terminology and not LC within UNEP/MAP.

	Sediments		Mussel	Fish
	EAC* IG.22/7(µg/kg dw)	MedEAC* IG.23/6(µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg dw)	EAC IG.22/7 and IG.23/6 (µg/kg lipid)
PCBs				
Sum 7 PCBs	11.5			
Pesticides				
γ-HCH (Lindane)	3		1.45	11 µg/kg ww
DDE(p,p')	2.2		5-50	
Hexachlorobenzene	20			
Dieldrin	2		5-50	

* ERL (Effects Range Low, Long et al. 1995, idem OSPAR values).

15. Further to this work, present document (Section 4) provides updated BC values for organochlorinated contaminants in sediments and mussel. They were calculated using the new data and the same methodologies as applied in 2016 and 2019 for other contaminants.

2.3 The methodologies for thresholds` determination used by UNEP/MAP

16. UNEP/MAP has adopted the threshold assessment methodology, based on the "traffic light" approach, by defining 2 values to classify 3 environmental categories: 1) good (acceptable, not different from BC); 2) above background but with low risk for environment and biota population, or below dietary limits for fish and sea food concerning human health; and 3) unacceptable. The two values defined were i) the Background Assessment Concentration (BAC) (or T_0) and ii) the Environmental Assessment Criteria (EAC) for TM and organic contaminants in sediments and biota, or EC for TM and organic contaminants in biota, (or T_1). The above Tables 1-5 tabulate the values of BAC and EAC adopted or proposed to be used for the assessment of the quality status of the Mediterranean Sea (IMAP Decisions 22/7 (COP 19) and 23/6 (COP 20)).

2.3.1 Background Assessment Concentration (BAC) determination

17. BAC are the concentrations below which no deterioration of the environment can be expected. Observed concentrations are said to be near BC if the mean concentration is statistically significantly below BAC. For calculation of BAC values from BC concentrations UNEP/MAP adopted the methodology that corresponds to the OSPAR methodology[19]. The BAC values were computed as the BC concentration multiplied by a factor that was determined based on the uncertainty (precision and accuracy) of the determinations. The multiplication factors were computed by applying the following equations: i) MedBAC for trace metals in sediments and shellfish: MedBAC=1.5xMedBC and in fish: MedBAC =2xMedBC; and ii) MedBAC for PAHs in sediments and mussel: MedBAC=1.5xMedBC. iii) MedBAC for organochlorinated contaminants in sediments and mussel were not calculated. Most of the data for the organochlorinated contaminants were below detection limit[20], therefore the proposed BCs should be re-examined when more data became available. Detailed elaboration is provided in the section 2.3.1 in UNEP/MED WG 533/Inf.3.

18. The MedBAC values endorsed in Decisions IG.22/7 and IG.23/6 are as follows: MedBAC for TM in sediments, mussel and fish (Tables 1,3), PAHs in sediments and mussel (Tables 2, 4). In 2019, the same methodology was used to propose derivation of specific sub-regional MedBAC values.

19. Further to work undertaken in 2019, this document proposes updated regional and sub-regional BAC values for the Mediterranean, using the same methodology as in 2019. The proposed values are presented in Section 4 along with elaboration also provided in UNEP/MED WG. 533/Inf.3.

[19] At present, no statistical assessment was possible for the precision of the monitoring data reported into MEDPOL/IMAP Info system given the quantity of data reported in IMAP info System/ MEDPOL, as well as a frequency of analyzing one sample of either biota or sediment is insufficient for calculation of the precision of monitoring data. Therefore, the variability from OSPAR monitoring program was used, following its application for an upgrade of the assessment criteria in in 2017 and 2019. A detailed explanation is given in section 2.3.1 of the information document UNEP/MAP WG.533/Inf.3.

[20] Annex III, document UNEP/MAP WG.533/Inf.3.

2.3.2 Environmental Assessment Criteria (EAC) determination

20. EAC values are the concentrations above which significant adverse effect to the environment or to human health are most likely to occur. Conversely, EAC values are defined as the concentrations below which it is unlikely that unexpected or unacceptable biological effects will occur in exposed marine species. Due to that fact that it was not possible to develop EAC for MED at that time, it was agreed to use the criteria developed by OSPAR and NOAA/USEPA (ERL values) (Long et al. 1995), as the EAC values for the Mediterranean. The EAC values agreed in Decisions IG.22/7 and IG.23/6 are as follows: EAC values for TM, PAHs and organochlorinated contaminants (PCBs and pesticides) are provided for sediments in Tables 1, 2 and 5; TM and organochlorinated contaminants are provided for mussel and fish in Tables 3 and 5 and PAHs are provided for mussel in Table 4.

21. A proposal of a new methodology to derive EAC values specific for the Mediterranean Sea is described in Section 4[21].

2.3.3 European Union regulations (EC)

22. The EAC values for TM and PAHs in biota as endorsed by Decisions IG.22/7 and IG.23/6 (Table 3) are the concentrations in fish and seafood recommended as dietary limits for human consumption concerning human health (EC). EC values are derived from the following EU Directives regulating maximum levels for certain contaminants in foodstuffs: EC/EU 1881/2006, 1259/2011, 488/2014 and 1005/2015. Section 4.3 gives more details about EC values. It should be mentioned that these values were set up to protect human health and may be too lenient to protect the environment.

23. A proposal of new methodology to derive EAC values for the Mediterranean Sea is described in Section 4[22].

2.4 The assessment criteria for IMAP Common Indicator 18

24. By Decisions IG.22/7 and IG. 23/6, the Contracting Parties endorsed BAC and EAC values for the following biomarkers for the mussel (*Mytilus galloprovincialis*): Acetylcholinesterase activity (AChE), Metallothioneins (MT), Micronuclei frequency (MN), Lysosomal membrane stability (LMS-NRR and LMS-LP methods) and Stress on Stress (SoS). These values are indicative and serve as the initial assessment criteria.

25. Presently there are no new data that can be used to update the biomarkers` assessment criteria. Therefore, they were not addressed in Section 4. More information on biomarkers and related criteria derivation is given in section 2.4. in UNEP/MAP WG.533/Inf. 3.

3 Survey of relevant data not used previously neither for preparation of the Mediterranean Quality Status Report (2017 MED QSR) nor for the State of Environment and Development Report (2019 SoED)

26. New relevant data not used previously neither for the 2017 MED QSR nor for update of the assessment for EO9 within preparation of the 2019 SoED were collected from the following 4 data sources:

1. New data from IMAP Pilot Info System that include national monitoring data uploaded in the system during its testing phase, and in particular after launching formal call for reporting of data in June 2020. This updated document takes into account monitoring data reported until 31 December 2021.
2. Data from the MEDPOL Database since 2015[23];
3. The EU data center (European Marine Observation and Data Network - EMODnet);
4. Published papers collected from the scientific literature.

[21] See in UNEP/MAP WG.533/Inf.3
[22] See in UNEP/MAP WG.533/Inf.3
[23] In view of the consultations with the OWG on Contaminants (UNEP/MAP WG.533/Inf.3, Annex I), data from 2015 onwards were included in the calculation, even if they were used previously, in order to increase the number of data points.

27. Details of the available data from these sources are elaborated in UNEP/MED WG. 533/Inf.3 and summarized here- below. It must be noted that level of data reported until 31 December 2021 was still less than 30 % of new data that need to be reported for the preparation of the 2023 MED QSR.

3.1 IMAP Pilot Info System and MEDPOL Database

28. Tables 6, 7 and 8 provide each a detailed examination of the new available data per contaminant category sorted by matrix, country and source of data. The datasets used in the 2017 and 2019 assessments are given in UNEP/MAP WG. 463/Inf.6 (2019).

29. It can be seen that the IMAP and MEDPOL data included only TM and organic contaminants in sediment and biota (CI17). No new data were available for biomarkers (CI18). New biomarker data were not available also for assessments that contributed to 2019 SoED.

Table 6[24]: An overview of the data available for trace metals in sediments and biota (*Mytilus galloprovincialis* and *Mullus barbatus*) for their use for the preparation of the 2023 QSR. The numbers next to the years are the number of observations for each parameter, sorted by country and data source. When available, IMAP-IS file number is given.

Source	IMAP_File	Country	Year	Cd	Hg	Pb
Sediment						
IMAP_IS	&	Albania	2020	6	6	6
IMAP_IS	&	Croatia	2019	30	30	30
EMODNet		Croatia	2017	37	37	37
IMAP_IS	125	Cyprus	2013-2018	22	22	22
IMAP_IS	224	France	2016	23	23	23
EMODNet		France	2016	27	27	27
Literature		Greece	2016-2018	0	0	115
IMAP_IS	410, &	Israel	2019-2020	30	30	30
MEDPOL		Israel	2015,2017	34	34	33
IMAP_IS	457,469	Italy	2015-2019	499	390	484
EMODNet		Italy	2015	2	5	5
IMAP_IS	118	Lebanon	2019	17	7	17
Literature		Lebanon	2017	2	3	3
IMAP_IS	489	Malta	2017-2018	22	22	22
IMAP_IS	&	Montenegro	2019-2020	41	41	41
MEDPOL		Montenegro	2016-2018	26	26	26
IMAP_IS	243	Morocco	2015-2018	44	22	44
IMAP_IS	204	Slovenia	2019	1	1	1
MEDPOL		Tunisia	2014	9	9	9
IMAP_IS	445,446	Turkey	2018	65	65	65
MEDPOL		Turkey	2015	21	21	21
Mytilus galloprovincialis						
IMAP-IS	&	Croatia	2019,2020	37	35	37
IMAP-IS	495	France	2018	23	23	23
MedPol		France	2015	24	24	24
EMODNet		France	2017	3	3	3
Literature		France	2014	0	17	0
IMAP-IS	460,494	Italy	2016-2019	26	109	26
EMODNet		Italy	2015-2018	7	61	7
IMAP-IS	&	Montenegro	2019-2020	20	20	20
MedPol		Montenegro	2018	8	8	8
IMAP-IS	439,&	Slovenia	2018-2020	9	9	9
MedPol		Slovenia	2016-2017	9	9	3
Mullus barbatus						
IMAP_IS	&	Croatia	2019,2020	11	10	11
IMAP_IS	41,351,410	Israel	2015,2018,2019	48	48	0

[24] A more detailed table is presented in UNEP/MAP WG533/Inf.3 (Table 6).

Source	IMAP_File	Country	Year	Cd	Hg	Pb
IMAP_IS	152	Lebanon	2019	14	14	14
IMAP_IS	489	Malta	2017,2019	5	5	5
MEDPOL		Montenegro	2018	8	8	8
IMAP_IS	323	Turkey	2015	25	25	25

&Reported to MEDPOL, to be added to IMAP_IS

Table 7[25]: An overview of the data available for PAHs in sediments and biota (*Mytilus galloprovincialis*) for their use for the preparation of the 2023 QSR, sorted by country and source of data. The numbers next to the years are the minimal and maximal number of observations for any PAH compound in the relevant years. When available, IMAP-IS file number is given.

Source	IMAP_File	Country	Year	Minimum	Maximum
Sediment					
IMAP_IS	&	Albania	2020	*	6
EMODNet		France	2016	29	29
Literature		Israel	2013	52	52
IMAP_IS	457,469	Italy	2016-2019	51	377
EMODNet		Italy	2015-2017	0	5
IMAP_IS	152	Lebanon	2019	0	19
IMAP_IS	489	Malta	2017-2018	0	25
IMAP_IS	&	Montenegro	2019-2020	41	41
MedPol		Montenegro	2018	0	6
IMAP_IS	204	Slovenia	2019	0	1
MedPol		Slovenia	2013-2018	0	27
Literature		Tunisia	2019	0	5
IMAP_IS	445,446	Turkey	2018	*	65
Mytilus galloprovincialis					
IMAP_IS	&	Albania*	2020	0	0
Literature		Algeria	2014	6	6
IMAP_IS	495	France	2018	22	23
EMODNet		France	2017	0	2
IMAP_IS	460,494	Italy	2016-2019	0	56
IMAP_IS	&	Montenegro	2019-2020	21	21
MedPol		Montenegro	2018	0	8
IMAP_IS	204,364,439	Slovenia	2015-2016,2019-2020	0	12
IMAP_IS	277	Spain	2015	0	42

&Reported to MEDPOL, to be added to IMAP_IS; * data for Total 4 or Total 5 PAHs

Table 8[26]: An overview of the data available for organochlorinated contaminants in sediments and biota (*Mytilus galloprovincialis*) for their use for the preparation of the 2023 QSR, sorted by country and source of data. The numbers next to the years are the minimal and maximal number of observations for any compound in the relevant years. When available, IMAP-IS file number is given.

[25] A more detailed table is presented in UNEP/MAP WG.533/Inf. 3 (Table 7).
[26] A more detailed table is presented in UNEP/MAP WG.533/ Inf.3 (Table 8).

Source	IMAP_File	Country	Year	Minimum	Maximum	Minimum	Maximum
				PCBs		Pesticides	
Sediment							
EMODNet		France	2016	29	29	0	29
IMAP_IS	457,469	Italy	2016-2019	126	183	0	364
EMODNet		Italy	2015	0	0	0	5
IMAP_IS	152	Lebanon	2019	0	19	0	0
IMAP_IS	489	Malta	2017-2018	0	0	0	22
IMAP_IS	&	Montenegro	2019-2020	41	41	24	41
Literature		Tunisia	2019	0	5	0	5
IMAP_IS	445-446	Turkey	2018	64	64	0	64
Mytilus galloprovincialis							
Literature		Algeria	2014	6	6	0	0
IMAP_IS	&	Croatia	2019	19	19	0	0
IMAP_IS	495	France	2018	0	23	0	23
IMAP_IS	460,494	Italy	2016-2019	0	30	0	106
IMAP_IS	&	Montenegro	2019-2020	21	21	0	0
IMAP_IS	277	Spain	2015	14	14	14	14

&Reported to MEDPOL, to be added to IMAP_IS

3.2 Data from the EU data center (European Marine Observation and Data Network - EMODnet)

30. Data from EMODnet used to complement data available in IMAP Pilot Info System and MEDPOL Database are summarized in Tables 6-8. Some of the data previously available only from EMODNet were now available in IMAP-IS and were used as reported there.

3.3 Data from the scientific literature

31. The available scientific papers reviewed in the preparation of this document are detailed in UNEP/MAP WG.533 /Inf. 3 (Annex II), including also literature sources recommended from the members of OWG on Contaminants. The data from the literature used to complement data available in IMAP Pilot Info System and MEDPOL Database are summarized in Tables 6-8. It is important to note that the papers are usually limited in scope, both spatially and temporally. Moreover, they usually include contaminated and reference sites, so care should be taken when utilizing the data for BC calculation or verification. The search was geared towards finding recent data, from samples collected since 2012, and towards data from the southern Mediterranean countries.

3.4 Examination of the new data

32. The new data available were examined and used for BC and BAC`s calculation, as appropriate. The computed values were then compared with the environmental criteria for the Mediterranean Sea as endorsed in Decision 23/6 (COP 20). Those are presented in section 4.

33. The additional data available since the original document was finalized in April 4th 2021 improved the calculations. However, data were still limited, therefore data from different years were aggregated per country and outliers identified (using box plots) and not considered in the calculation of the median values. When needed, data were transformed to the concentration units requested by IMAP. It should be mentioned that sediment data were not normalized.

34. This comparison was undertaken in order to confirm data relevance for computing the updated BC and BAC values (Section 4). An in-depth examination of the data is presented in UNEP/MAP WG.533/Inf.3 (Annex III).

4 Critical examination of recommended environmental criteria and proposals for their update

35. In line with Decision 22/7 (COP 19), the assessment criteria for the Mediterranean Sea should follow the "traffic light" system for both contaminant concentrations and biological responses where two thresholds and three status categories are defined. As explained above, the two values defined were the Background Assessment Concentration (BAC) (T_0) and the Environmental Assessment Criteria (EAC) or EC values (T_1), (see Section 2).

4.1 Updated BC and BAC values for IMAP CI 17

36. The new data presented and critically analyzed above in Section 3 were used to calculate BC values for the sub-regional areas of the Mediterranean and for the whole Mediterranean Sea using the same methodology as initially applied in 2016/2017 and replicated in 2019 (see detail explanation in Section 2)[27]. BAC values for trace metals were calculated by multiplying the BCs by a factor, as follows: MedBAC=1.5 x MedBC (for mussel and sediment matrices); MedBAC=2.0 x MedBC (fish). For PAH in sediments, it is proposed to use MedBAC=1.5 x MedBC[28] . When most of the data originated from one sub-region, and there were significant differences among them, the BC values were calculated for the sub-region(s) only. It is noted that when applying the environmental quality assessment using the BAC their large variability (up to >100%), as presented in the re-calculated values for 2017, 2019 and 2022, should be considered. Thus, it is suggested to consider this variability for each sub-region or basin-wide in assessing GES. It should be noted that in the GES assessment the choice of thresholds should take this uncertainty into account.

37. Tables 9-13 present the new updated BC and BAC values. The tables include also the values of the assessment criteria as endorsed in Decision 23/6 (COP 20), as well as their values updated in 2019.

Table 9. BC and BAC values for trace metals in sediments, calculated from the new data available for upgrade of the criteria in present document (marked with 2022). Concentrations are given in µg/kg dry wt, as requested by IMAP. The number of data points (n) taken to calculate the BCs appear below the values. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

BCs							
TM	Med (cores)	Med (surf)	MED	WMS	ADR	CEN	AEL
	2011[29]		**2019**				
Cd	100	20	85	91.2	92.3		56
Hg	30	10	53	60	106.8		31.2
Pb	20000	2310	16950	20465	13932		4920
Proposed new updated BC values (2022)							
Cd			107	140	120	#	78.9
n			*803*	*351*	*300*	*31*	*158*
Hg			50.0	90.0	50.0	#	31.5
n			641	241	218	24	147
Pb			15000	16000	15700	1805	15674
n			*927*	*318*	*325*	*29*	*272*

[27] The calculation was performed using also the limit of detection (LOD) or the limit of quantitation (LOQ) values provided by the countries addressed as below detection limit (bdl) values (see Annexes I and III in UNEP/MAP WG.533/Inf.3).
[28] The calculation of the multiplication factor to calculate BACs for PAHs in sediments was not provided in the previous UNEP/MAP documents (2011, 2016, 2019). Looking at the OSPAR values for BC and BAC for PAHs in the sediments, the multiplication factor used depended on the compound and ranged from 1.6 to 2.1.
[29] The values calculated in 2011 are shown for comparison. The values were calculated from data compiled from the scientific literature (UNEP/MAP 2011) and need no recalculation.

BACs							
		IG.23/6	Med	WMS	ADR	CEN	AEL
		2017	**2019**				
Cd		127.5	127.5	136.8	138.5		84.0
Hg		79.5	79.5	90.0	160		46.8
Pb		25425	25425	30698	20898		7380
Proposed new updated BAC values (2022)							
Cd			161	210	180	#	118
Hg			75.0	135	75.0	#	47.3
Pb			22500	24000	23550	2708	23511

#All data points for Cd are bdl as well as 72% of the Hg data points.

38. It can be seen that the proposed new updated regional Mediterranean BC value for Cd is similar to the one calculated in 2011 from sediment cores while value for Hg is higher and for Pb is lower. Comparison to the BCs values updated in 2019 shows that presently updated regional BC values for Cd is higher, Hg is similar and Pb slightly lower. Comparison of the sub-regional BC values calculated in 2019 and 2022 shows differences as well, in particular Pb for the AEL sub-region. However, the BC for Pb at the AEL is similar to those calculated for the WMS and ADR. Possible reasons for these differences could be due to different sediment mineralogical composition and the location of the sampling stations, as well as the number of data points used in the calculation. It was possible to calculate BC for Pb at the CEN sub-region in 2022, however with only 29 data points (see Table 9). Comparison of the new updated BC values among the sub-regions showed that for Cd and Hg, the concentrations were higher in the WMS, followed by ADR and then AEL. Pb concentrations were similar. The number of data points among the sub-regions taken for the calculation were similar for the WMS and the ADR sub-regions, and lower for the AEL (ca. half the number of data points for Cd and Hg). 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.

Table 10. BC and BAC values for PAHs in sediments, calculated from data available for upgrade of the criteria in present document (marked with 2022). Concentrations are given in µg/kg dry wt, as requested by IMAP. The number of data points (n) taken to calculate the BCs appear to the right of the values *(inclined)*. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

PAH compounds	**UNEP/MAP (2011)**		**Proposed new updated BC values (2022)**									
	BC, Sed cores	BC, Sur sed	MED	*n*	WMS	*n*	ADR	*n*	CEN	*n*	AEL	*n*
Naphthalene	4		2.00	*217*	8.0	*24*	2.0	*165*	#	22	2.3	*49*
Acenaphthylene	0.5	1.05	(1.0)#	*208*	#	*25*	#	*132*	0.4	5	#	*52*
Acenaphthene	0.38	0.45	(2.0)#	*278*	#	*70*	#	*139*		*0*	#	*52*
Fluorene	0.75	0.33	(2.0)#	*270*	#	*88*	#	*139*	0.4	5	#	*41*
Phenanthrene	4.55	3.95	3.10	*212*	14.9	*25*	3.5	*155*	0.8	5	3.1	*48*
Anthracene	0.8	1.56	(2.2)#	*452*	#	*212*	#	*140*	#	28	#	*35*
Fluoranthene	5.6	6.7	5.00	*357*	#	*204*	7.0	*143*	0.1	23	2.7	*47*
Pyrene	10.28	2.1	6.20	*239*	24.8	*88*	8.0	*132*	0.4	5	3.0	*43*
Benzo[a]anthracene	3.45	1.28	3.38	*262*	19.7	*87*	4.1	*155*		*0*	1.8	*50*
Chrysene	1.3	6.64	2.70	*244*	35.9	*75*	4.6	*156*	1.6	5	1.6	*49*
Benzo(b)fluoranthene	1.1	8.32	5.00	*292*	8.7	*144*	15.0	*121*		*0*	2.6	*50*
Benzo(k)fluoranthene	0.53	6.03	4.00	*335*	#	*147*	3.0	*153*		*0*	#	*46*
Benzo[a]pyrene	2.55	3.71	(4.0)#	*397*	#	*201*	4.0	*154*	#	28	1.0	*48*
Benzo[g,h,i]perylene	1.25	3.25	(4.2)#	*370*	#	*205*	5.7	*155*		*0*	1.8	*49*
Dibenz[a,h]anthracene	0.18	1.37	(1.0)#	*246*	7.0	*89*	#	*143*		*0*	#	*50*
Indeno[1,2,3-c,d]pyrene	1.7	4.49	(4.0)#	*384*	#	*201*	4.4	*155*		*0*	2.1	*51*

Total PAHs			27.4	*178*	160	*26*	41.0	*107*	6.3	5	21.4	*60*
			Proposed new updated BAC values (2022)									
PAH compounds			MED		WMS		ADR		CEN		AEL	
Naphthalene			3.0		12.0		3.0		#		3.5	
Acenaphthylene			(1.5)#		#		#		0.6		#	
Acenaphthene			(3.0)#		#		#				#	
Fluorene			(3.0)#		#		#		0.5		#	
Phenanthrene			4.7		22.4		5.3		1.2		4.7	
Anthracene			(3.3)#		#		#		#		#	
Fluoranthene			7.5		#		10.5		0.2		4.1	
Pyrene			9.3		37.1		12.0		0.6		4.5	
Benzo[a]anthracene			5.1		29.6		6.2				2.7	
Chrysene			4.0		53.9		6.9		2.4		2.4	
Benzo(b)fluoranthene			7.5		13.0		22.5				3.8	
Benzo(k)fluoranthene			6.0		#		4.5				#	
Benzo[a]pyrene			(6.0)#		#		6.0		*#*		1.5	
Benzo[g,h,i]perylene			(6.3)#		#		8.6				2.7	
Dibenz [a,h]anthracene			(1.5)#		10.5		#				#	
Indeno[1,2,3-c,d]pyrene			(6.0)#		15.0		6.5				3.2	
Total PAHs			41.0		240		61.5		9.5		32.0	

#most data (>50%) below detection limit

39. The additional data reported by the CPs in the IMAP-IS up to 31 December 2021 improved the calculation of the BCs for PAHs in sediments. The number of data points used for calculation of BC for the whole Mediterranean increased by 7 times, compared to the data available until February 2021, while for WMS, ADR and CEN by 3-20 times on average. It was possible to calculate new proposed BCs also for the AEL sub-region due to new data as available until February 2021. However, BC for the sub-regions were calculated only when less than 50% of the data points were below the detection, to prevent bias due to different detection limits among countries (see Annex III, UNEP/MED WG. 533/Inf 3)[30]. The calculated BC values for the whole Mediterranean for most of the compounds were higher than the BC concentrations measured in sediment cores and surficial sediments of the Mediterranean Sea in 2011, while for a few compounds they were similar or lower. However, for 8 compounds, the Mediterranean BC values were calculated with more than 50% values BDL. This could be the one of the reasons for the differences. The BC values calculated for the WMS sub-region were higher than those calculated for the whole Mediterranean. The calculated values for the ADR were lower than for the WMS, and higher or similar to the values of the Mediterranean while for the AEL the values were lower. The lowest values were calculated for the CEN, however the number of data points was low and not representative. Therefore, it is proposed to use presently updated values of BC/BAC for preparation of input assessments for 2023 MED QSR, along with further update of the assessment criteria if more data will be reported by the CPs[31]. Moreover, it is recommended to add the concentration of Total[32] (16) PAHs to the list of parameters in addition to reporting of the concentrations of individual 16 PAHs.

Table 11. BC and BAC values for trace metals in mussel (*M. galloprovincialis*) and fish (*M. barbatus*)[33] calculated from data available for upgrade of the criteria in present document (marked with 2022) The table

[30] See Annex III in UNEP/MAP WG.533/Inf.3
[31] The values for a few of the compounds in Table 10 are 0, meaning that the concentrations measured were BDL Section 4.1, UNEP/MAP WG.533/Inf.1, addresses the topic of BDL concentrations.
[32] In addition to Total PAH (16 compounds), UNEP/MAP DD cites the following Total PAHs from the EEA reference list of contaminants: Total PAHs (4 PAHs: Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) (EEA_33-62-5); Total PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene) (EEA_33-56-7); Total Benzo(b)fluoranthene + Benzo(k)fluoranthene (EEA_32-23-5) and Total Benzo(g,h,i)perylene + Indeno(1,2,3-cd)pyrene (CAS_193-39-5) (EEA_32-24-6.
[33] Available data for trace metals in other biota species are presented in Annex IV in UNEP/MED WG.533/Inf.3.

presents also the values as calculated in 2019 (marked 2019) and previously endorsed values. The units of concentrations are given as requested by IMAP. The number of data points (n) taken to calculate the values appear below the values.

BCs						
TM		**MED**	**WMS**	**ADR**	**CEN**	**AEL**
Mussel soft tissue (*M. galloprovincialis*), µg /kg dry wt						
		2019				
Cd		730	660.5	782		942
Hg		115.5	109.4	126		110
Pb		1542	1585	1381		2300
Proposed new updated BC values (2022)						
Cd		710	1030	629	78	>
n		*165*	*53*	*108*	*4*	
Hg		77.9	85.0	75.4	12	>
n		*300*	*121*	*168*	*8*	
Pb		1100	1260	1000	#	>
n		148	51	94	4	
BACs						
	Med	**MED**	**WMS**	**ADR**	**CEN**	**AEL**
TM	IG.23/6 (2017)	**2019**				
Cd	1095	1095	991	1173		1413
Hg	173.2	173.2	164.1	189		165
Pb	2313	2313	2378	2072		3450
Proposed new updated BAC values (2022)						
Cd		1065	1545	944	117	
Hg		117	128	113	18.4	
Pb		1650	1890	1500	#	

BCs						
TM		MED	WMS	ADR	CEN	AEL
Fish muscle (*Mullus barbatus*) µg/kg wet wt, calculated in 2019						
Cd		*3.7				
Hg		50.6	68	150.5		44.6
Pb		*31	38			20
Proposed new updated BC values (2022)						
Cd		3.9		5.3		3.6
n		*98*		*19*		*87*
Hg		40.6		120		33.7
n		*97*		*18*		*81*
Pb		18.3		40.8		13.5
n		*58*		*19*		*39*
BACs						
	MED	MED	WMS	ADR	CEN	AEL
	IG.23/6 (2017)	**2019**				
Cd	*3.7#	#3.7				
Hg	101.2#	101.2	136	301		89.2
Pb	*31#	#31	76			40
Proposed new updated BAC values (2022)						
Cd		7.8		10.6		7.2
Hg		81.2		240		67.4
Pb		36.6		81.6		27.0

*MedBAC in Decision IG.23/6; # Most values BDL; > it is recommended to use the values calculated in 2019.

40. The regional MedBC values for Hg and Pb in *M. galloprovincialis* calculated in 2022 were lower than those calculated in 2019, while Cd BCs were similar. The sub-regional BCs for the WMS

and the ADR were also different: WMS BC for Cd was higher and Hg and Pb lower in 2022 compared to 2019. In the Adriatic the BC concentrations were lower in 2022 than in 2019. In 2019 the values in the ADR were higher than in the WMS while in 2022 they were lower. The differences in the Adriatic could be due to different locations of the sampling stations and to a temporal decrease. 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. Since new data were not available in the AEL to update BC/BAC values for *M. galloprovincialis*, it is recommended to use the values calculated in 2019.

41. The main data for trace metals in muscle of M. barbatus originated from the AEL sub-region, therefore the comparison for all sub-regions between 2019 and 2022 values were limited. The regional MedBC values for Cd and Hg in the muscle of the fish *M. barbatus* calculated in 2022 were similar to the ones calculated in 2019, while Pb was lower in 2022. The concentrations in the AEL in 2022 were slightly lower than for the whole Mediterranean, while in the ADR the concentrations were higher than in the Mediterranean, in particular Hg and Pb. The concentrations in the ADR were also much higher than in the AEL. Comparison to 2019 showed that in the ADR Hg was lower in 2022 and in the AEL, Hg and Pb were lower in 2022. 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.

42. The mussel *M. galloprovincialis* and the fish *M. barbatus* are agreed as IMAP mandatory species. However, they may not be always found in all the areas of the Mediterranean Sea. Therefore, the addition of other (mandatory area specific) species to the monitoring program is recommended for further consideration. The species should be chosen based on their presence in the sub-regions, and relevance as pollution indicators, what will allow a better environmental assessment Data from different species are presented in Annex IV UNEP/MED WG. 533/Inf.3.

43. The reporting of new data from CPs to the IMAP-IS allowed for the calculation of new proposed BC and BAC values for PAHs in the mussel *M. galloprovincialis* (Table 12). The calculated BC values for the whole Mediterranean for some of the compounds were higher than the BC concentrations calculated in 2019, while for others they were similar or lower. As for sediments, data with bdl values were taken in the calculation of the new proposed BCs[34]. The bdl values were different, depending on the country and even different within the same country. Moreover, bdls values constituted 12-90% of the data points depending on the compound[35]. This could be the one reason for the differences.

Table 12. Proposed BC and BAC values for PAHs in the mussel *M. galloprovincialis* calculated from data available for upgrade of the criteria in present document (marked with 2022). The table shows also the values as calculated in 2019 (marked 2019) and previously endorsed values. Concentrations are given in µg/kg dry wt, as requested by IMAP. The number of data points (n) taken to calculate the BCs appear to the right of the values. No data were available for the CEN and AEL sub-regions. When most (>50%) of the data points were below the detection limit for the sub-regions, BCs were not calculated.

UNEP/MAP (2019) BC					
PAH compounds		MED	WMS	ADR	AEL
Naphthalene		(2.4)#	2.24		2.80
Acenaphthylene		(0.6)#			
Acenaphthene		(0.6)#			
Fluorene		1.0	0.96	1.07	0.60
Phenanthrene		7.1	4.93	9.04	7.55
Anthracene		0.5	0.52	0.38	0.30
Fluoranthene		3.0	3.38	2.03	6.60
Pyrene		2.0	3.02	0.85	5.90

[34] See Annex I in UNEP/MAP WG.533/Inf.3.
[35] See Annex III in UNEP/MAP WG.533/Inf 3.

Benzo[a]anthracene		0.8		1.20		0.53		1.60
Chrysene		1.0		1.24		0.27		5.20
Benzo(b)fluoranthene								
Benzo(k)fluoranthene		0.6		1.27		0.29		1.50
Benzo[a]pyrene		0.5		0.60		0.32		0.70
Benzo[g,h,i]perylene		0.9		0.90				1.20
Dibenz[a,h]anthracene		0.5		0.53				
Indeno[1,2,3-c,d]pyrene		1.2		1.23				0.90
Proposed new updated BC values (2022)								
		MED	*n*	WMS	*n*	ADR	*n*	
Naphthalene		0.56	*40*	0.52	*20*	#	*17*	
Acenaphthylene		(0.05)#	*39*	#	*20*	#	*21*	
Acenaphthene		(0.50)#	*49*	#	*23*	#	*21*	
Fluorene		2.50	*88*	7.87	*68*	#	*21*	
Phenanthrene		5.35	*87*	19.9	*68*	2.25	*19*	
Anthracene		1.12	*87*	0.94	*65*	#	*21*	
Fluoranthene		4.83	*130*	10.0	*86*	#	*23*	
Pyrene		2.50	*76*	5.54	*62*	#	*18*	
Benzo[a]anthracene		0.60	*90*	0.69	*56*	#	*35*	
Chrysene		2.54	*72*	2.98	*54*	#	*19*	
Benzo(b)fluoranthene		1.00	*106*	1.36	*56*	#	*39*	
Benzo(k)fluoranthene		1.00	*107*	0.73	*57*	#	*40*	
Benzo[a]pyrene		(1.00)#	*134*	0.94	*80*	#	*40*	
Benzo[g,h,i]perylene		1.00	*107*	0.67	*59*	#	*39*	
Dibenz[a,h]anthracene		(0.10)#	*82*	#	*55*	#	*21*	
Indeno[1,2,3-c,d]pyrene		(0.63)#	*111*	0.29	*51*	#	*40*	
Total 16 PAHs[36]		5.80	*48*	5.60	*19*	6.60	*25*	
UNEP/MAP (2019) BAC								
	MedBAC IG.23/6	MED		WMS		ADR		AEL
Naphthalene		(3.6)#		3.4				4.2
Acenaphthylene		(0.9)#						
Acenaphthene		(0.9)#						
Fluorene	2.5	1.5		1.4		1.6		0.9
Phenanthrene	17.8	10.7		7.4		13.6		11.3
Anthracene	1.2	0.8		0.8		0.6		0.5
Fluoranthene	7.4	4.5		5.1		3.0		9.9
Pyrene	5.0	3.0		4.5		1.3		8.9
Benzo[a]anthracene	1.9	1.2		1.8		0.8		2.4
Chrysene	2.4	1.5		1.9		0.4		7.8
Benzo(b)fluoranthene								
Benzo(k)fluoranthene	1.4	0.9		1.9		0.4		2.3
Benzo[a]pyrene	1.2	0.8		0.9		0.5		1.1
Benzo[g,h,i]perylene	2.3	1.4		1.4				1.8
Dibenz[a,h]anthracene	1.3	0.8		0.8				
Indeno[1,2,3-c,d]pyrene	2.9	1.8		1.8				1.4
Proposed new updated BAC values (2022)								
		MED		WMS		ADR		
Naphthalene		0.84		0.79		#		
Acenaphthylene		(0.08)#		#		#		
Acenaphthene		(0.75)#		#		#		
Fluorene		3.75		11.8		#		
Phenanthrene		8.03		29.8		3.38		
Anthracene		1.68		1.40		#		

[36] Data dictionary gives 2 additional categories: Total 4 PAHs Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) and Total 5 PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene). It is suggested that they be considered for use in the future data reporting.

Fluoranthene		7.25		15.0		#		
Pyrene		3.75		8.31		#		
Benzo[a]anthracene		0.90		1.04		#		
Chrysene		3.81		4.46		#		
Benzo(b)fluoranthene		1.50		2.04		#		
Benzo(k)fluoranthene		1.50		1.09		#		
Benzo[a]pyrene		(1.50)$^{\#}$		1.42		#		
Benzo[g,h,i]perylene		1.50		1.01		#		
Dibenz[a,h]anthracene		(0.14)$^{\#}$		#		#		
Indeno[1,2,3-c,d]pyrene		(0.94)$^{\#}$		0.43		#		
Total 16 PAHs[37]		8.70		8.40		9.90		

$^{\#}$most data (>50%) below detection limit

44. The reporting of new data from CPs to the IMAP-IS also allowed for the calculation of BACs for organochlorinated contaminants (PCBs and pesticides) in sediments and in M. galloprovincialis (Table 13) (See Paragraph 14). BACs for organochlorinated contaminants were not calculated in 2011, nor in 2016 or in 2019. Most of the data for the organochlorinated contaminants were below detection limit[38], therefore the proposed BACs should be re-examined when more data became available.

Table 13. Proposed BAC values for organochlorinated contaminants (PCBs and pesticides) in sediments and in the mussel *M. galloprovincialis* (MG), calculated from data available for upgrade of the criteria in present document (marked with 2022). Concentrations are given in µg/kg dry wt, as requested by IMAP. The number of data points (n) taken to calculate the BACs appear to the right of the values. For sediments, very limited data were available for the CEN sub-region while for biota, no data were available for the CEN and AEL sub-regions. When most (>50%) of the data points were below the detection limit for the sub-regions, BACs were not calculated.

Proposed BAC values (2022)										
SEDIMENT	MED	*n*	WMS	*n*	ADR	n	CEN	n	AEL	n
PCBs										
PCB28	0.10	*271*	#	*74*		*137*	#	5	0.09	*57*
PCB52	0.07	*243*	0.10	*69*	0.09	*112*	#	5	0.04	*60*
PCB101	0.10	*227*	0.16	*68*	0.16	*101*		0	#	*55*
PCB118	0.10	*222*	0.46	*61*	0.18	*105*	#	5	0.01	*55*
PCB138	0.11	*233*	0.26	*66*	0.24	*105*	#	5	#	*54*
PCB153	0.14	*226*	0.40	*69*	0.28	*102*	#	5	0.02	*54*
PCB180	0.09	*236*	0.13	*67*	0.13	*108*	#	5	#	*55*
Sum 7 PCBs	0.40	*179*	1.60	*71*	0.21	*31*	#	5	0.19	*68*
Pesticides										
γ-HCH (Lindane)	(0.1)$^{\#}$	*474*	#	*242*	#	*168*		0	0.02	*64*
DDE(p,p')	(0.1)$^{\#}$	*64*	0.23	*26*	#	*35*	#	5		*0*
Hexachlorobenzene	(0.1)$^{\#}$	*325*	#	*156*	#	*155*	#	22		*0*
Dieldrin	(0)$^{\#}$	*105*		*0*	#	*41*	#	5	#	*64*
BIOTA - MG	MED	*n*	WMS	*n*	ADR	*n*	CEN	n	AEL	n
PCBs										
PCB28	0.20	*66*	0.07	*43*	1.38	*40*				
PCB52	0.38	*102*	0.3	*43*	0.5	*65*				
PCB101	1.20	*76*	1.1	*43*	1.4	*40*				
PCB118	1.23	*56*	1.5	*20*	1.4	*40*				
PCB138	2.31	*102*	2.4	*43*	3.3	*70*				
PCB153	3.45	*104*	4.6	*43*	4.6	*70*				
PCB180	0.50	*73*	0.3	*43*	0.5	*40*				
Sum 7 PCBs	18.4	*58*	28.6	*20*	17.3	*40*				
Pesticides										

[37] Data dictionary gives 2 additional categories: Total 4 PAHs Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) and Total 5 PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene). They may be considered in the future.
[38] See Annex III in UNEP/MAP WG.492/Inf.11.

γ-HCH (Lindane)	(1.0)#	*67*	#	*37*	#	*30*				
DDE(p,p')	3.05	*11*	3.05	*11*		*0*				
Hexachlorobenzene	(0.5)#	*135*	#	*87*	#	*56*				
Dieldrin	(1.0)#	*35*	#	*37*		*0*				

most data (>50%) below detection limit

45. For determination of BC values for CI17, the following key findings can be provided:

- For some parameters there is a marked difference among the Mediterranean sub-regions. Therefore, it is proposed in those cases (i.e. Cd and Hg in sediments, Cd in *M. galloprovincialis*, sum of PAHs in sediments), to consider using the sub-regional Mediterranean Sea assessment criteria.
- A statistical treatment of BDL has been recommended by OWG on Contaminants as explained above in paragraph 36 and section 4.1. of UNEP/MED WG.533/Inf.3. It is recognized that the different BDLs make it hard to use half of the BDL concentration for these values. However, it is not reasonable not to take BDL values into consideration. In this document, the calculations were performed with the bdl values as reported by the countries.
- An in-depth examination of more data points, that need to be reported by CPs, should be performed in particular when large differences were observed between the BC values calculated in 2016, 2019, 2021 and 2022. This is true for TM in sediment and biota in all sub-regions. The examination should include, among others, characterization of the stations used (hot spot, reference, other), as requested for mandatory data reporting regarding CI 17 to IMAP-IS, analytical methodology, normalization, temporal trends. The reporting the new data to IMAP-IS up to 31 December 2021, improved the recalculation of the upgraded BCs that was presented in 2021.
- The reporting of new data to IMAP-IS made it possible to calculate BCs for PAHs in biota, and BACs for organochlorinated contaminants in sediment and biota, that was not possible in the previous UNEP/MAP documents from 2016 and 2019 and in 2021. However, many of the data points are bdl and more data need to be reported to improve the recalculation the BCs. Before new data availability will allow their recalculation, present re-calculated values remain valid for preparing assessment inputs for the 2023 MED QSR.

4.2 An upgraded approach for updating EAC values for IMAP CI 17 and CI 18

46. As explained above (see Section 2), the EAC values endorsed for use in the Mediterranean Sea were NOAAs ERLs (for TM, PAH and pesticides in sediments) and the ECs from EU Directives to protect human health (for TM and organic contaminants in biota). They may be too lenient if the goal is to achieve and maintain GES where the contaminants cause no significant impact on coastal and marine ecosystems. However, EAC values cannot be updated based on existing monitoring data. It needs a very specific in-depth research of the ecotoxicological and environmental scientific literature.

47. Therefore, the methodology detailed in European Commision Guidance Document (2018) and in Long et al. (1995) is recommended for the update of Mediterranean EAC values. It includes a thorough examination of the scientific literature conducted to study where data on no effect or adverse biological effects are given in conjunction with chemical data in the environment and in the biota at the same site and time. Those include but are not limited to sediment toxicity tests, aquatic toxicity tests in conjunction with equilibrium partitioning (EqP) and field and mesocosm studies. Laboratory results on biomarkers (CI18) are also important for the derivation of the EAC values. The data should be assembled into a detailed database and analyzed, as well as the extent of the effect determined. The emphasis should be given to Mediterranean biota species.

48. Upgrade of the EAC values for Mediterranean Sea as recommended above is a long-term task that needs a dedicated, very specific, scientific research. More detailed elaboration is provided in UNEP/MED WG.533/Inf 3.

4.3 Proposal of new EAC values for IMAP CI 20

49. Proposal of the EAC values for IMAP CI 20 related to actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed sea food is based on a survey of existing sources, including Directives of EU related to the maximum permitted levels for contaminants in fish and seafood for the protection of human health. Table 14 details the concentrations cited at different sources for TM (Cd, Hg and Pb). ~~and~~ Concentrations for organic contaminants (PCBs, dioxin) are given in the text (Paragraph 52)[39].

50. From Table 14 it is possible to see that the criteria are taxa specific (fish, mussel, crustacean), as well as species specific. For example, maximum allowable Hg concentration in fish muscle is 0.5 mg/kg ww, excluding listed species such as bonito, marlin, halibut, mullet species, among others, in which the maximum allowable Hg concentration in the muscle is 1.0 mk/kg ww (see EC/EU Directive 1881/2006).

51. In addition, Decision IG.23/6 details the indicative regional EAC values for PAHs in mussels (*Mytilus galloprovincialis*) and for organic contaminants in mussel (*Mytilus galloprovincialis*) and fish (*Mullus barbatus*) that are considered biota matrix of IMAP Common Indicator 17. These values are given in Tables 4 and 5. As these values were set up to protect human health, they may be too lenient to protect the environment (see paragraph 22). However, since the values are based on the maximum levels for certain contaminants in foodstuffs as provided in EC/EU Directives 1881/2006, 1259/2011 and amendments 488/2014 and 1005/2015, they are proposed to be also used for IMAP CI 20.

Table 14. Compilation of maximum levels for trace metals in fish and seafood for the protection of human health[40]. The concentrations are presented in mg/kg ww.

		Cd	**Hg**	**Pb**
Source	**matrix**		mg/kg ww	
NOAA (see countries below)	fish	0.2	0.5-1	1.5-2
	canned fish (^~~*~~tuna)		1^~~*~~	2.5, 5[^~~*~~]
	mollusc	2	0.5	2.5
	finfish	0.1		0.5
EU 1881/2006 directive and 488/2014 and 1005/2015 amendments	fish muscle	0.05-0.25	0.5-1	0.3
	cephalopods	1		~~0.3~~1
	crustaceans	0.5	0.5	0.5
	bivalve mollusc	1		1.5
CODEX Alimentarious (2019)	mollusc, cephalopod	0.05-2		
	fish			0.3
	fish- species dependent		1.2-1.7*	
#MedEAC IG.23/6	Mussel	1	0.5	1.5
	fish	0.05	1	0.3
OSPAR 2017	All species - biota	1	0.5	1.5
~~Minimum~~	~~-~~	~~0.05~~	~~0.5~~	~~0.01~~
~~Maximum~~	~~-~~	~~2~~	~~1.7~~	~~2.5~~

^ ~~There is no value for Hg in mollusc in the EU directive~~Values in tuna fish; * methyl-mercury, # Concentrations recalculated in mg/kg wet wt

[39] Table 14 presents maximum permitted levels for contaminants in fish and seafood for the protection of human health. However, risk assessment to human health (eg. based on daily food intake, population sensitivity) is further addressed in the literature.

[40] The following sources are used in Table 14 and paragraph 54:
NOAA (National Oceanic and Atmospheric Administration) tabulation of the export requirements by country for fish and seafood (among others) (https://www.fisheries.noaa.gov/export-requirements-country-and-jurisdiction-f). Requirements by Australia, Brazil, Chile, China and Equador for trace metals;
EU directives for maximum levels for certain contaminants in foodstuffs (EC/EU 1881/2006 , 1259/2011 Directives and amendments 488/2014 and 1005/2015);
CODEX Alimentarius international food standards, guidelines and codes of practice. Joint FAO/WHO Food Standards Programme .

52. The maximum levels of organic contaminants in fish and seafood for the protection of human health are as follows: NOAA, 0.5 and 2 PCB (mg/kg ww) in fish and other seafood, respectively; EU Directive 1881/2006, 2-5 and 6 (mg/kg ww) of benzo(a)pyrene and 12-30 and 35 (mg/kg ww) for the sum of benzo(a)- pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene in smoked fish muscle and on smoked bivalve mollusc, respectively; EU Directive 1259/2011 – 3.5 pg/g ww for the sum of dioxins in fish muscle and liver and in eel muscle; 6.5, 10 and 20 pg/g ww for the sum of dioxins and dioxin like PCBs in fish muscle, in eel muscle and in fish liver, respectively; and 75, 300 and 200 ng/g of the sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 in fish muscle, in eel muscle and in fish liver, respectively. As for TM, the maximum allowable concentrations are taxa specific.

53. The values as established by above EU Directives are submitted for consideration to present meeting in order to guide the Secretariat and the Parties on their application as EAC values for IMAP CI 20. These values are in the low and mid-range of criteria used around the world and has the advantage to be consistent with regulations of EU. Their consistent application across the region is necessary. It should also be highlighted that these values were agreed at EU level also considering the ecosystem characteristics of Mediterranean Sea.

Annex I
References

References

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

Appendix 2

The pilot example for Marine Environment Assessment in the Areas with Insufficient Data: The Results of GES Assessment for IMAP Common Indicator 17 in the Levantine Sea Data Standards and Data Dictionaries for IMAP Common Indicator 18

1 Introduction

1. Eutrophication is a process driven by enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, leading to: increased growth, primary production and biomass of algae; changes in the balance of nutrients causing changes to the balance of organisms; and water quality degradation (IMAP, 2017).[1] Seawaters depending on nutrient loading and phytoplankton growth are classified according to their level of eutrophication. Low nutrient/ phytoplankton levels characterize oligotrophic areas, water enriched in nutrients is characterized as mesotrophic, whereas water rich in nutrients and algal biomass is characterized as eutrophic.

1.1 Rationale

2. A significant amount of research has been done in developing and intercalibrating biological indicators to assess impact of eutrophication in coastal waters (Borja et al., 2013)[2]. Phytoplankton is the most suitable for assessing eutrophication due to direct response to nutrient conditions (Devlin et al., 2007).[3] However, less attention has been directed to linking ecological status to management actions and establishing meaningful and consistent nutrient criteria to support achievement of GES (Hering et al., 2015).[4]

3. The European experience is relevant in the field. A comparison of nutrient boundaries set for the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) in transitional, coastal and marine waters across EU Member States (Dworak et al., 2016)[5] revealed a huge variability in nutrient concentrations boundaries, but also in other relevant aspects such as the nutrient parameters and metrics used, the time of year assessed, the reference conditions established.

4. However, in the Mediterranean region there are many differences in the nutrients` parameters assessed, the assessment period (summer, year-round, i.e., annual), and in the statistic used (mean, median or 90^{th} percentile) within assessment of the conditions of saline waters.

5. The choice of statistical measures used to aggregate nutrients` samples from a chosen assessment period to determine the concentrations of monitored parameter/indicator is also important. Since statistical distributions of Chl*a* and nutrients tend towards lognormality, the parameter that better estimates the value around which central clustering occurs, is represented by the geometric mean, i.e. the arithmetic mean of log-data reconverted into numbers. The normalization of the data distributions by means of log transformation stabilizes the variance, with a standard deviation (SD) practically constant in the case of decimal log-transformation (Giovanardi and Tromellini, 1992)[6]. These statistical properties indicate that the use of the annual geometric mean of data as the metric for setting the assessment criteria in Mediterranean is the appropriate statistical measure.

[1] IMAP (2017) Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria, UN Environment/MAP Athens, Greece, pp 52.

[2] Borja, A., Elliott, M., Henriksen, P., and Marb, N. (2013). Transitional and coastal waters ecological status assessment: advances and challenges resulting from implementing the European water framework directive. Hydrobiologia 704, 213–229.

[3] Devlin, M., Best, M., Coates, D., Bresnan, E., O’Boyle, S., Park, R., et al. (2007). Establishing boundary classes for the classification of UK marine waters using phytoplankton communities. Mar. Pollut. Bull. 55, 91–103.

[4] Hering, D., Borja, A., Carstensen, J., Carvalho, L., Elliott, M., and Feld, C. K. (2010). The European water framework directive at the age of 10: a critical review of the achievements with recommendations for the future. Sci. Total Environ. 408, 4007–4019.

[5] Dworak, T., Berglund, M., Haider, S., Leujak, W. and Claussen, U. (2016). A comparison of European nutrient boundaries for transitional, coastal and marine waters. Working Group on ecological Status ECOSTAT.

[6] Giovanardi, F., Tromellini, E., (1992). An empirical dispersion model for total phosphorus in a coastal area: the Po River-Adriatic system. Sci. Total Environ. Supplement 201–210.

2 Calculation of the assessment criteria for Chl*a*, DIN and TP in the Adriatic Sub-region

6. The scientific experience related to eutrophication in the Adriatic Sea Sub-region is huge and relay on the problems derived from the eutrophic pressure connected with the Po River watershed where live around 16 000 000 inhabitants. Near the scientific experience, also a huge data set exists, that altogether enabled development of TRIX (Volenweider et al., 1998)[7], an index for the assessment of the eutrophication, and a regional approach for development of classification criteria based on Chl*a* within IMAP (Giovanardi et al., 2018)[8]. This also supports further development of a harmonized approach to the definition of reference conditions and boundary values for DIN and TP based on the relationship between pressures and responses. The work elaborated in this document was undertaken in line with the procedure proposed and elaborated for the Adriatic Sea Sub-region in the documents UNEP/MED WG.492/11[9] and UNEP/MED WG.492/Inf.12[10]. For open (offshore) waters the assessment criteria for Chl*a* were also calculated, while for coastal waters the assessment criteria for Chl*a* remain as adopted in IMAP Decision IG.22/7 (COP 19, 2016)[11] (see below Table 9).

7. For the purpose of setting the assessment criteria ‘Coastal water’ means surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured.

2.1 Data availability and statistical approach

8. 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 to propose the values of the sub-regional assessment criteria for Chl*a*, TP and DIN. Data reported by Albania, Bosnia and Herzegovina and Greece were missing or were insufficient to be used. The geographical coverage and stations for which data were provided are shown in Table 1 and on Figure 1.

***Table 1**. Sampling period, stations, and number of data records in the dataset that was used for calculation of the assessment criteria.*

Country	Sampling period	Stations	Number of data records
Croatia	2016-2019	20	6 216
Italy	2015-2020	54	415 188
Montenegro	2015-2019	12	6 204
Slovenia	2015-2020	12	13 147

[7] Vollenweider, R.A., F. Giovanardi, G. Montanari, A. Rinaldi, (1998). Characterization of the Trophic Conditions of Marine Coastal Waters. Environmetrics, 9, 329-357.

[8] Giovanardi, F., Francé, J., Mozetič, P., Precali, R. (2018). Development of ecological classification criteria for the Biological Quality Element phytoplankton for Adriatic and Tyrrhenian coastal waters by means of chlorophyll a (2000/60/EC WFD). Ecological Indicators. 93. 316-332.

[9] UNEP/MED WG.492/11 (2021) Agenda item 6: Cross-Cutting Issues -The Integration and Aggregation Rules for IMAP Ecological Objectives 5, 9 and 10 and Assessment Criteria for Contaminants and Nutrients., Assessment Criteria Methodology for IMAP Common Indicator 13: Pilot Application in Adriatic Sub-region.

[10] UNEP/MED WG.492/Inf.12 (2021) Agenda item 6: Cross-Cutting Issues -The Integration and Aggregation Rules for IMAP Ecological Objectives 5, 9 and 10 and Assessment Criteria for Contaminants and Nutrients, Analysis of the Methodologies Available for Establishment of the Assessment Criteria for IMAP Common Indicator 13.

[11] COP 19 (2016). Decision IG.22/7 - Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria. COP 19, Athens, Greece. United Nations Environment Programme, Mediterranean Action Plan, Athens.

9. A more detailed analysis of data availability for calculation of the assessment criteria in the Adriatic Sea Sub-region is presented in the Annex I.

10. Data elaboration and presentation were performed by using R, an open-source language widely used for statistical analysis and graphical presentation (R Development Core Team, 2022)[12]. Maps are elaborated using QGIS 3.24, an open-source GIS tool.

Figure 1. The stations used to propose the assessment criteria for the Adriatic Sea sub-region. Data collected in the period from 2015 to 2020 were used.

11. Data were aggregated, evaluated and corrected when necessary, using the database management software Paradox for Windows 11. Prepared data were transferred to R and additionally validated and transformed using the database capabilities of R. Special care was dedicated to the handling of Below Detection Limit (BDL) data since they may represent a substantial part of the data and introduce erratic evaluation. The BDL data were recalculated using the *NADA* (Nondetects and Data Analysis for Environmental Data) statistical package in R. *ROS* estimator were used i.e., all BDL values were statistically elaborated and can only be used for the calculation of averaged values.

12. *ROS* function in R is an implementation of a Regression on Order Statistics. It is a semiparametric method for censored data that assumes an underlying parametric distribution for the uncensored values. The method is based on a simple linear regression model using ordered detected values and distributional (normal or log-normal) quantiles to estimate the concentration of the censored values. It is a procedure of probability plotting and regression that imputes the censored data using the estimated parameters of a linear regression model of uncensored observed values vs their normal quantiles (or log-normal quantile).

13. The required assumption is that the response variable is a linear function of the normal (log-normal) quantiles. The imputed values are only used collectively to estimate summary statistics and

[12] 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

they are not considered estimates for specific samples. It is recommended for large (n>50) data sets with less than 50% censoring and multiple censoring levels as for small (n<50) data sets with less than 80% censoring and multiple censoring levels. It can also be used for data sets with only one censoring level. The reconstructed data set (where for BDL *ROS* values were substituted) were used to build the assessment criteria for the concentration of Chl*a*, TP and DIN.

14. 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.

15. R scripts and outputs for the calculation of RC and boundary values for Chl*a*, TP and DIN are presented in Annex II.

2.2 Water typology

16. The Water typology is very important for further development of classification schemes of a certain area. The first step in setting reference conditions and boundary values for an area, i.e., in present case in the Adriatic Sea Sub-region, is to identify the water types (WTs) present in the area and to attribute to them the data related to the density or salinity boundary values, as established by IG.22/7 (COP 19, 2016). The subdivision of major coastal WTs is based only on salinity that is perfectly comparable with the ones that are based on density (Table 2). The use of salinity only was proposed during the intercalibration process for WFD (Carletti and Heiskanen, 2009)[13].

Table 2. *Water types in the Adriatic Sea Sub-region*

	Type I	**Type IIA, IIA Adriatic**	**Type IIIW**
σt (density)	<25	25<d<27	>27
S (salinity)	<34.5	34.5<S<37.5	>37.5

17. For the Adriatic Sea Sub-region the relevant water types are Type I, Type IIA Adriatic and Type III W, as it is presented in Figure 2. For the identification of the WTs, it is suggested to use the five years surface average (Carletti and Heiskanen, 2009). However, in the present work undertaken for the Adriatic Sea Sub-region, all data *G_Mean* by stations were used since the data availability varies from 4-6 years only, depending on the status of data reporting by the CPs (Table 1), as well as on rather unequal number of samplings by year. The calculated WT was attributed to the data for further elaboration of data by WTs.

2.3 Reference conditions

18. Reference Conditions (RCs) represent "a description of the biological quality elements that exist, or would exist, at high status". That is, with no, or very minor disturbance from human activities. The objective of setting reference conditions` standards is to enable the assessment of ecological quality against these standards (WFD CIS Guidance Document No. 5 (2003))[14].

19. As suggested in the procedure proposed and elaborated in the documents UNEP/MED WG.492/11 and UNEP/MED WG.492/Inf.12, the dilution factor (FDil) was used for the definition of the reference conditions based on the concentrations of Chl*a*. The delimitation line between the values and the absence of values represents the line that can be interpreted as the threshold between natural and anthropogenic pressures. It is assumed that the nutrient loads, either natural or generated by minor

[13] Carletti, A., Heiskanen, A. S. (2009). Water Framework Directive intercalibration technical report. Part 3: Coastal and Transitional waters. JRC-IES EUR 23838 EN/3, pp 244.

[14] WFD CIS Guidance Document No. 5 (2003) Transitional and Coastal Waters Typology, Reference Conditions and Classification Systems.

human activities, determine a response of the coastal systems that is well-represented by concentrations of Chla lying on the curve (Figure 3).

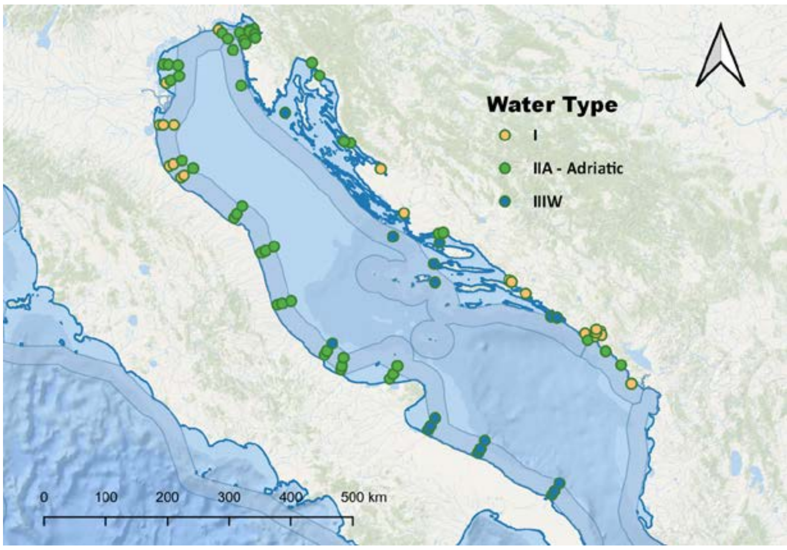


Figure 2. The distribution of WTs on the monitoring stations that were used to propose sub-regional assessment criteria for the Adriatic Sea sub-region.

20. The same approach cannot be used for the nutrients, given FDil represents an integrated measure of the nutrients' pressures to the ecosystem. The reference conditions for nutrients are derived from the pressure to effects relationship.

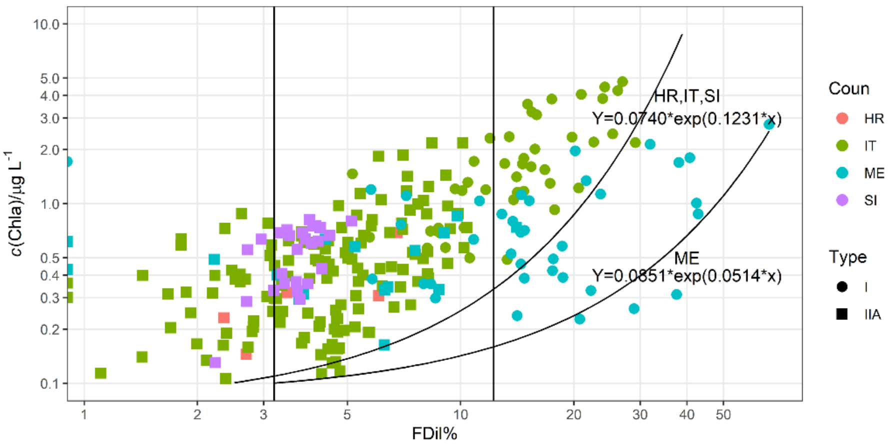


Figure 3. Scatter plot of annual G_means of chlorophyll a (Chl*a*) against the dilution factor (FDil) for Types I and IIA Adriatic. The curve marks the boundary of the lower limit of Chl*a* reference condition values (RCs). The vertical lines represent the WT boundaries set as FDil and calculated from salinity boundaries in Table 2 (explained further in the text).

21. The FDils were calculated in relation to the average salinity at 10 m of the most outward stations (supposed to represent not influenced waters) for three zones of the Adriatic Sea Sub-region (northern Adriatic – 38.60, central Adriatic – 38.80 and southern Adriatic – 38.90). For the FDil boundary calculation, salinity of 38.77 was used. The WT boundary for IIA Adriatic (Table 2) is 34.5<S<37.5 and gives the FDil of 10.97<FDil<3.28. These WT boundaries based on FDil represent the less influenced waters in the class and are a good estimator for the reference condition of the WTs IIA Adriatic and I.

22. The best functional relationships between RC for Chl*a* and FDil were always exponential. The equations describing these relationships have been used to derive unique reference conditions for

Chl*a* per WTs corresponding to the boundary value of FDil. Table 3 summarizes the results of the calculation that was undertaken.

Table 3. *Summary table for BQE phytoplankton reference conditions (RCs) based on Chla.*

Country	**Type**	**Functional relationships**	**F_dil (%) Border**	**RC - Chl-a (µg/L) as G_Mean**
CRO, IT, SI	Type I	$y = 0.0740\ e^{0.1231x}$	10.97	0.29
ME		$y = 0.0851\ e^{0.0514x}$	10.97	0.15
CRO, IT, ME, SI	Type IIA Adriatic.	$y = 0.0740\ e^{0.1231x}$	3.28	0.11

23. From figure 3 it appears that the WT I for Montenegro is different from the rest of the Adriatic Sea, and it is practically confined to the Boka Kotorska Bay. The WT IIA Adriatic follows the rest of the Adriatic Sea.

2.4 Pressure to effect relationship

24. Defining pressure to effect relationship is critical for setting the reference conditions of nutrients. To test the sensitivity of the selected metrics to different pressure indicators, multiple regression analysis with linear models (LMs) was performed. By means of this stepwise regression technique, the concentration of Chla variations was tested against TRIX components (TP, DIN, absolute percentage deviation from oxygen saturation (as aD_O)) and FDil as pressure indicators.

25. The *stepAIC* function from package *MASS* with *direction* (backward) was used. The residual normality and heteroscedasticity can be easily controlled from the plot function of the *MASS* package. Log10 transformed data were used.

26. For Type I among all the possible combinations, the stepwise regression technique provided the following linear model:

lm(formula = Chla ~ DIN + aD_O, data = Type_I)

27. The fitted linear model explains 43% of the total Chl*a* variability and the maximum weight in determining this variability accounts for DIN. A summary statistic is provided in Table 4.

Table 4. *Results of the stepwise regression applied to Type I coastal waters data. For each regression coefficient (estimate), the value of the Student's test (under hypothesis β = 0), the relative P-value and the degree of significance expressed by the number of asterisks, are provided.*

	Estimate (β)	**t value**	**Pr(>|t|)**	**Sign.**
(Intercept)	-0.48660	-6.336	$1.35e^{-8}$	***
DIN	0.68686	7.676	$3.72e^{-11}$	***
aD_O	0.13539	2.510	0.0141	*
*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*				
R^2: 0.4306, F: 29.87 on 2 and 79 DF, p: $2.181e^{-10}$				

28. For Type IIA Adriatic water, the linear model provided by the stepwise regression technique was:

lm(Chla~ TP + DIN + FDil, data = Type_IIA)

29. The linear model retains three regressors with a largely dominant weight of TP and DIN over the weight of FDil (Table 5). Moreover, multiple R_squared shows that the amount of Chl*a* variability explained by this model is only 23%.

Table 5. *Results of the stepwise regression applied to Type IIA Adriatic data. For each regression coefficient (estimate), the value of the Student's test (under hypothesis β = 0), the relative P-value and the degree of significance expressed by the number of asterisks, are provided.*

	Estimate (β)	**t value**	**Pr(>|t|)**	**Sign.**
(Intercept)	-0.74682	-14.667	< 2e-*16*	***
TP	-0.36696	-6.293	1.9^{e-9}	***
DIN	0.21336	3.875	0.000144	***
FDil	0.10993	2.579	0.010622	*
*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*				
Multiple R^2: 0.2249, F-statistic: 19.53 on 3 and 202 DF, P-value: $3.678e^{-11}$.				

30. The above calculated relationships showed that Chl*a* sensitivity, considered as the response of coastal systems to the availability of nutrients in terms of phytoplankton biomass production, is not largely controlled by total phosphorus as observed in the WFD data for the period 2007-2009, that was on other hand used for the previous definition of WFD BQE Phytoplankton boundaries by Giovanardi et al (2018) and then transposed to IMAP assessment criteria for Chl*a* (IMAP, 2017) in the Adriatic Sea Sub-region. A significant part of calculations, specifically in waters of WT I, shows that the concentration of DIN can explain up to 40% of the concentration of Chl*a*, from which it can be therefore assumed that DIN holds the role of the main pressure indicator. All these findings must be tested further since these relationships were tested only at the level of the whole Adriatic, as data availability for the eastern part of the Adriatic does not allow to test these considerations at more detailed scales.

31. The important regression equations, obtained from regression models that are presented below in Figures 4 and 5, are used subsequently for the construction of the assessment criteria that are summarized in Table 6. It is very important to recognize that the definition of WFD ecological classification was performed for data collected from 2007 to 2009 and located in the coastal waters i.e. in internal waters or from the coastal line up to 1 Nm. The data collected from 2015 to 2020 are located in the open waters of Italy i.e., from the coastal waters outward. For Croatia and Slovenia, the locations are very close to that set for the period from 2007 to 2009. The data of Montenegro are collected with appropriate quality for the period from 2015 to 2019 and the stations are in the coastal waters.

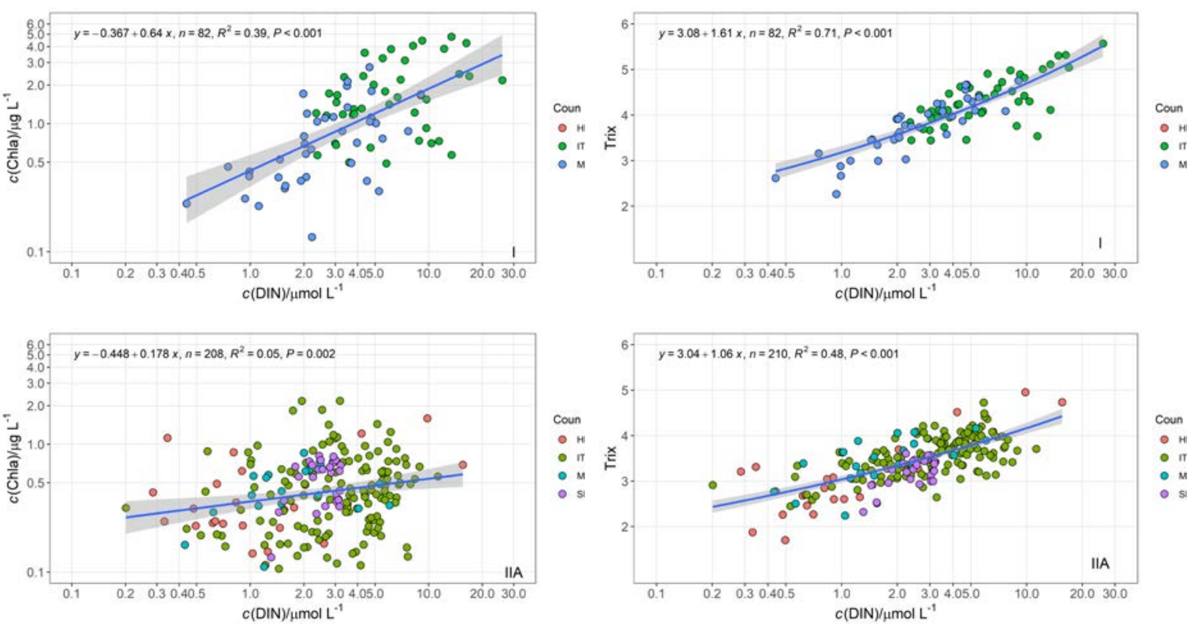


Figure 4. Scatter plot of annual *G_means* of chlorophyll a (Chl*a*, left) and Trophic index (TRIX, right) against the concentration of DIN for WT I and IIA Adriatic. A Linear model regression line with standard errors is plotted over the data. Equation, number of data, R^2 and p-values are shown in the upper corner.

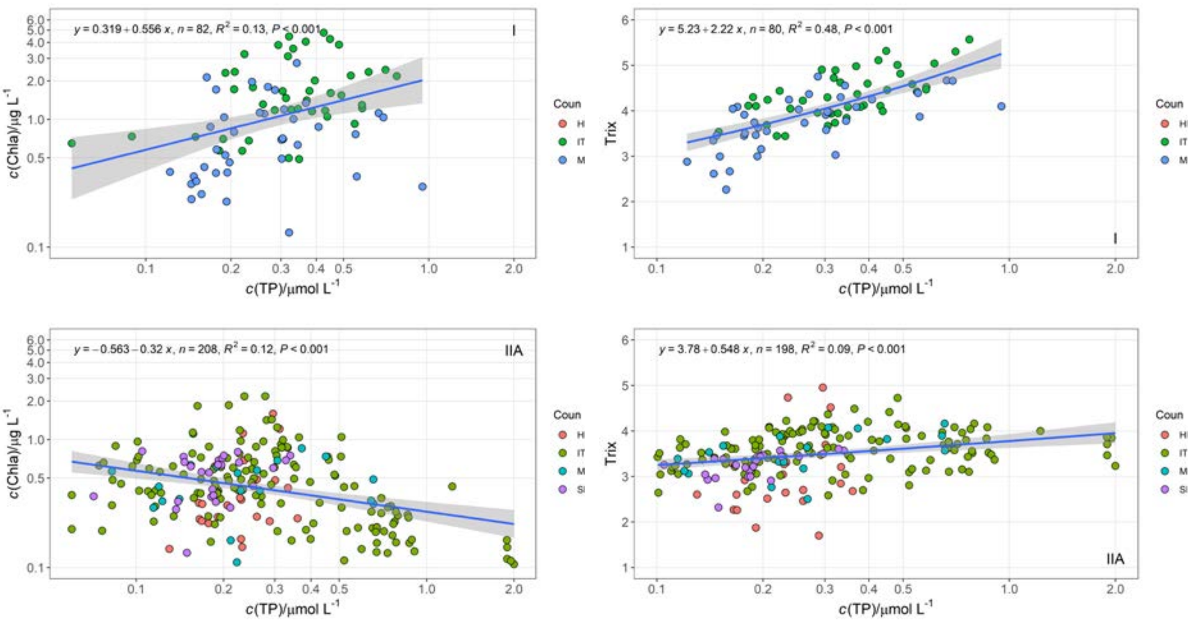


Figure 5. Scatter plot of annual *G_means* of chlorophyll *a* (Chl*a*, left) and Trophic index (TRIX, right) against the concentration of TP for WT I and IIA. A Linear model regression line with standard errors of mean is plotted over the data. Equation, number of data, R^2 and p-values are shown in the upper left corner.

Table 6. *List of functional relationships of interest provided per WTs. For each regression equation, the sample size N, R-squared and p-values are provided.*

Functional link	Period	Type I	Type IIA Adriatic
1.TP vs TRIX	2007-2009	**[TP] = exp [(TRIX – 6.064)/1.349] N = 15**	**[TP] = exp [(TRIX – 6.148)/1.583] N = 52**
	2015-2020	**[TP] = 10^ [(TRIX - 5.23)/2.22] N = 80; R2 = 0.48; P <0.001**	**[TP] = 10^ [(TRIX - 3.78)/0.548] N = 198; R2 = 0.09; P <0.001**
2. DIN vs TRIX	2007-2009	-	-
	2015-2020	**[DIN] = 10^ [(TRIX –3.08)/1.61] N = 82; R2 = 0.71; P <0.001**	**[DIN] = 10^ [(TRIX – 3.04)/1.06] N = 210; R2 = 0.48; P <0.001**
3. Chla vs TP	2007-2009	**[Chla] = 10.591 [TP] 1.237 N = 15; R2 = 0.835; P = 4.45 10-6**	**[Chla] = 3.978 [TP] 1.347 N = 52; R2 = 0.896; P = 2.2 10-16**
	2015-2020	**[Chla] = 2.084 [TP] 0.556 N = 82; R2 = 0.13; P <0.001**	**[Chla] = 0.274 [TP] -0.32 N = 208; R2 = 0.12; P <0.001**
4. Chla vs DIN	2007-2009	-	-
	2015-2020	**[Chla] = 0.4295 [DIN] 0.64 N = 82; R2 = 0.39; P <0.001**	**[Chla] = 0.3565 [DIN] 0.178 N = 208; R2 = 0.05; P =0.002**
From Giovanardi et al., 2018		**Used for 2015-2020 evaluation**	

32. The nature of these relationships has been almost always of *log-log* type, which provides the highest degree of correlation. The equations in rows 1 and 2 were obtained from the inverse relationship between the TRIX index and its components TP and DIN. For Type I and IIA Adriatic, these equations were prepared separately per WT, using the same data as those used to assess the functional relationships between TP and DIN, and Chla. Finally, the equations in rows 3 and 4 exploit

the relationship between TP and DIN, and Chla, with the aim of fixing the limits among the ecological quality classes of the assessment criterion, both for reference conditions and boundaries values.

3 The proposal of the reference conditions and boundary values for Chl*a*, DIN and TP for the Adriatic Sea sub-region

33. With the definition of nutrients` RCs for WT I and WT IIA Adriatic, coastal waters and the unveiling of their pressure-impact relationships, all the necessary tools are provided for defining the classification criteria for Biological Quality Element (BQE) phytoplankton in the Adriatic coastal waters. Given the Trophic Index (TRIX, Vollenveider et al, 1998) was developed first for the northern Adriatic and its ecological use is well known, it was used as an internal scale in setting the boundary values for the whole Adriatic Sub-region.

34. From the functional relationship given in Table 6 (and presented in Figures 3 and 4) based on statistical relevance, only the relationship between Chl*a* and DIN can be used for fixing the limits between ecological classes and only for WT I. It can also be observed that the TRIX values are not exceeding 5.5 for WT I and 5 for WT IIA Adriatic, indicating that in general, the waters are in the worst case in good ecological status. For that reason, only limits between ecological classes up to the G/M boundary are proposed as provided in Table 7. All this is indicating that most of the adverse processes, from the eutrophication point of view, are happening in the coastal waters. Observing from the point of the geographical scale, probably the underlying processes show even greater variability.

35. Therefore, the first step was to calculate the RCs for WT I from the functional relationship between Chla and DIN (Table 6, row 4). That resulted in the following RC values for DIN: i) 0,66 µmol/L for HR and ~~,~~ IT ~~and SI~~, and ii) 0,21 µmol/L for ME.

36. The next in setting the boundaries was the definition of the most important boundary value i.e., the Good/Moderate (G/M) boundary, which delimits the need for taking measures in case of good ecological status failure. Firstly, the boundary value was set for DIN, as it appeared to be the best pressure indicator for phytoplankton for WT I, as explained above. The G/M boundary for DIN was calculated using the equations in row 2 of Table 6, at the corresponding TRIX boundary between Good and Moderate Trophic Status (TRIX = 5; Giovanardi et al, 2018), which matches the transition from mesotrophic to eutrophic conditions in the coastal ecosystem. For WT I, G/M boundary value of TRIX was increased to 5.25, in order to take into account the nutrient loads originating from natural sources carried by the rivers into the Adriatic Sea, presumably in not negligible amounts. From the G/M boundary for TRIX, the G/M boundary for DIN was set at 22.3 µmol/L for WT I. In the same manner all possible boundaries` values for WT I and WT II A were calculated (Tables 7 and 8).

37. In tables 7 and 8 the values of the assessment criteria i.e. the reference conditions and boundary values for open (offshore) waters were calculated from the data reported for the period from 2015 to 2020 as available with sufficient quality in the IMAP Pilot Infosystem. The values of the assessment criteria for coastal waters are from Giovanardi et al. (2018) and the G/M values for Chl*a* in coastal waters are as approved in the IMAP Decision IG.22/7 (COP 19, 2016)). As the data for the coastal waters were not provided for Italy, the Croatian data for the eastern part of the Adriatic are not sufficient for the calculation of the assessment criteria for the period from 2015 to 2020 in that part of the Adriatic. Therefore, it is suggested to use the values obtained for the definition of the classification criteria for Biological Quality Element (BQE) phytoplankton for the WFD (Tables 7 and 8), as it was suggested by the Online Working Group on Eutrophication (2015) and established by IMAP Decision (IG.22/7,COP 19, 2016). For WT I the boundary values can be calculated up to the M/P threshold due to the fact that the data ranges never reach values higher than 5.5 for TRIX. This indicates that processes of advanced eutrophication are not underway in the Adriatic Sea Sub-region.

38. For WT IIA Adriatic (Table 8) data show that the assimilation processes (TRIX up to 5 as presented in Figures 3 and 4) in the open (offshore) waters are not expressed indicating the oligotrophic character of the waters. Given that, setting the assessment criteria for this WT is not reliable.

Table 7. *Reference conditions and boundary values as annual G_Mean for Chla, TP, DIN for WT I for the Adriatic Sea coastal and open (offshore) waters.*

Boundaries	**TRIX**	**Coastal waters**		**Open (offshore) waters**	
		c(Chla)/μg L-1	**c(TP)/μmol L-1**	**c(Chla)/μg L-1**	**c(DIN)/μmol L-1**
RC	-	1.4[b]	0.19[a]	0,15*; 0.29**	0.21*; 0.66**
H/G	4.25	2.0[a]	0.26[a]	1.25	5.3
G/M	5.25	5.0[b]	0.55[a]	3.1	22.3
M/P	6.25	12.6[a]	1.15[a]	7.8	93.1
P/B	7	25.0[a]	2.00[a]		
*for ME; **for CRO, IT, SI					
[a]From Giovanardi et al, 2018; [b]G/M boundaries for Chla as approved in IG.22/7					

Table 8. *Reference conditions and assessment criteria boundaries as annual G_Mean for Chla, TP, DIN for WT IIA Adriatic coastal and open (offshore) waters.*

Boundaries	**TRIX**	**Coastal waters**		**Open (offshore) waters**	
		***c*(Chl*a*)/μg L-1**	***c*(TP)/μmol L-1**	***c*(Chl*a*)/μg L^{-1}**	***c*(DIN)/μmol L^{-1}**
RC	-	0.33[b]	0.16[a]	0.11	
H/G	4.25	0.64[a]	0.26[a]		
G/M	5.25	1.5[b]	0.48[a]		
M/P	6.25	3.5[a]	0.91[a]		
P/B	7	8.2[a]	1.71[a]		
[a]From Giovanardi et al, 2018; [b]G/M boundaries for Chl*a* as approved in IG.22/7					

Type III W Adriatic

39. Following the same approach used for Type I and IIA Adriatic waters, overall *G_means* of nutrients` concentrations were related to the concentration of Chl*a* for WT III W waters. No correlation (Figure 5) was found both for TP (R^2<0.01; P=0.732) and DIN (R^2=0.05; P=0.093). Additionally, overall values of *G_mean* of Chla range from around 0.1 to around 0.4 µg/L. Since the ecological classification scheme consists of 5 ecological quality classes, the discrimination limit between the two contiguous Chla annual *G_mean* values would not be suitable for proper and safe classification (Giovanardi *et al*., 2018). For that reason, a single threshold value is therefore proposed for WT IIIW waters in Adriatic; it is the H/G value for WT IIA Adriatic in coastal waters of 0.64 µg/L for Chl*a* and 0,26 µmol/L for TP.

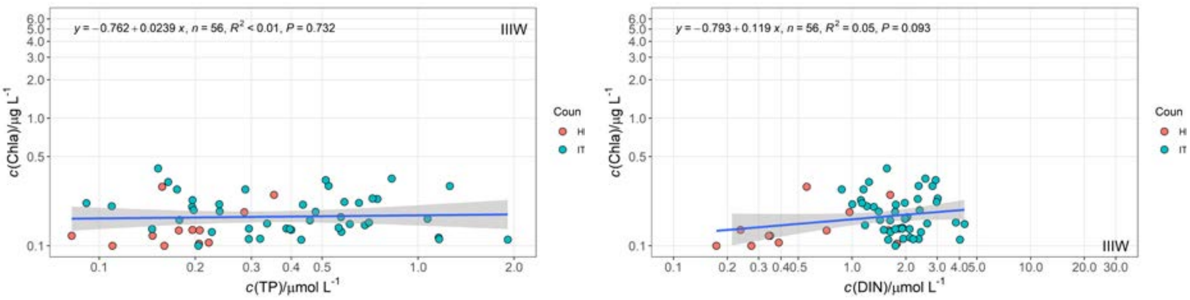


Figure 5. Scatter plot of annual G_means of chlorophyll a (Chl*a*) against the concentration of TP (left) and DIN (right) for WT III W in Adriatic waters. A Linear model regression line with standard errors is plotted over the data. Equation, number of data, R^2 and p-values are reported in the upper corner.

4 Key findings

40. Reference conditions and G/M assessment criteria boundary values as annual G_Mean for Chl*a*, TP and DIN for the Adriatic Sea Sub-region coastal and open (offshore) waters are proposed as provided in Table 9. Based on the findings presented in this document, they are proposed for consideration and approval of the present meeting.

Table 9. *Reference conditions and G/M boundary values as annual G_Mean for Chla, TP, DIN for the Adriatic Sea sub-region coastal and open (offshore) waters.*

Water type	**Boundaries**	**Coastal waters**		**Open (offshore) waters**	
		***c*(Chl*a*)/µg L-1**	***c*(TP)/µmol L-1**	***c*(Chl*a*)/µg L^{-1}**	***c*(DIN)/µmol L^{-1}**
WT I (in the Adriatic Sea Sub-region)	RC	1.4[b]	0.19[a]	0.15*; 0.29**	0.21*; 0.66**
	G/M	5.0[b]	0.55[a]	3.1	22.3
WT IIA Adriatic	RC	0.33[b]	0.16[a]	0.11	-
	G/M	1.5[b]	0.48[a]	-	-
*for ME; **for CRO, IT~~, SI~~					
[a]From Giovanardi et al, 2018; [b]G/M boundaries for Chl*a* as approved in IG.22/7					

41. For the purpose of the further upgrades of the assessment criteria i.e. reference conditions (RCs) and boundary values for DIN, TP and Chl*a*, as a minimum the following datasets need to be reported by the CPs: three continuous years of monitoring with a minimum monthly frequency for Water types I and IIA and bimonthly to seasonal for Water type III. It should also be noted that other supporting

parameters (i.e. temperature, salinity and dissolved oxygen) need to be available for defining the water typology.

42. For open (offshore) waters TRIX values for WT I have never reached the values higher than 5.5 and indicates that processes of advanced eutrophication are not underway in the Adriatic Sea Sub-region. For WT IIA Adriatic, data show that in the open (offshore) waters the assimilation processes (TRIX up to 5) are not expressed indicating their oligotrophic character.

43. The proposed RC and G/M boundary values are valid for the Adriatic Sea Sub-region only. There is a need for urgent reporting of new and all pending monitoring data by the Contracting Parties to IMAP Info System for the other three Mediterranean sub-regions i.e. the Western Mediterranean Sea Sub-region (WMS), the Central Mediterranean Sea Sub-region (CEN) and the Aegean and Levantine Seas (AEL) Sub-region. It is a prerequisite for decision - making on the application of the tools and methods that will be found optimal for the calculation of the RCs and boundary values in CEN, WES and AEL. Attention also needs to be paid to the possible use of the methodological approaches recommended in UNEP/MED WG. 493/11. This complex task has to be undertaken under the leadership of the Contracting Parties, including through the Online Working Group (OWG) for Eutrophication (EO5), as recommended by the Meeting of CorMon on Pollution Monitoring (April, 2021).

Annex I

Data analysed for calculation of the reference and boundary values in the Adriatic Sea Sub-region

The elaboration of data available for calculation of the assessment criteria for DIN and TP in the Adriatic Sea Sub-region includes the following sources:

1) New data from IMAP Pilot Info System that include national monitoring data reported during its testing phase, and in particular after launching a formal call for data reporting in November 2021;

2) All monitoring data from the MEDPOL Database (i.e. data reported before 2012 that were uploaded into the MEDPOL Database along with data reported in the period from 2013 to 2019 to MEDPOL outside the MEDPOL Database in the format of old metadata templates); these data were migrated to the IMAP Pilot Info System.

3) Data reported to the EMODNET database by Croatia, Italy and Slovenia were undertaken and controlled. However, the format of these datasets did not allow for their use in the calculation of the assessment criteria.

A summary of data reported both to the IMAP Pilot Info System and the MEDPOL Database is presented in Table 1.

Table 1. Datasets from the IMAP Pilot Info System and the MEDPOL Database available for calculation of the assessment criteria for DIN and TP.

Country	**Data reported to the MEDPOL Database** **	**Data reported to IMAP Pilot Info system***	
		Validated	**Not validated**
Albania	2005-2006	***	
Bosnia and Hercegovina	2006-2008	2013-2020	
Croatia	2009, 2011-2014	-	2016-2019
Italy	-	-	2015-2020
Montenegro	2008-2012; 2014-2015; 2016-2017	-	2018-2019
Slovenia	1999-2013, 2015-2016	2017-2020	

*Both validated and not validated data have been used to increase data points for calculation of the assessment criteria for DIN and TP, given temporary not validated status may be assigned to data due to certain technical issues in IMAP Pilot Info System

** Given the insufficient quantity of data reported in the period from 2018 to 2022, all data reported up to 2017 to the MEDPOL database were taken into account

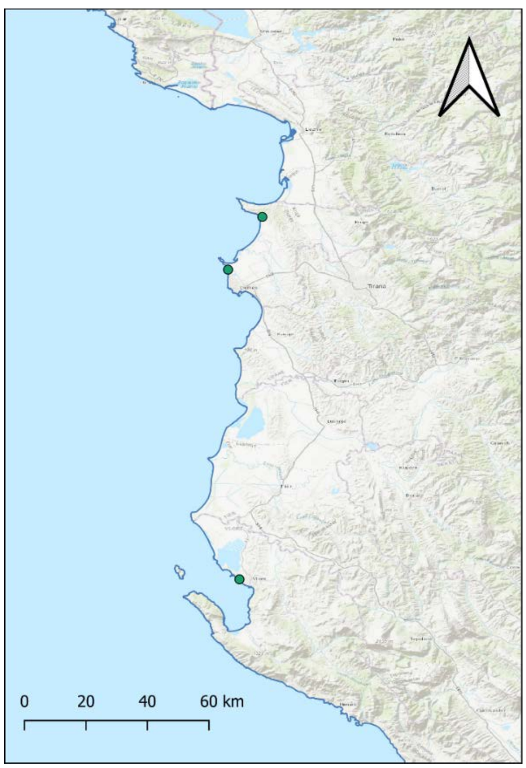
***Before the finalization of the present work, there was no improvement in insufficient quality of data generated at a few monitoring stations in Albania in 2019 within the GEF Adriatic Project.

It can be concluded that data available for calculation of the assessment criteria (i.e., reference conditions (RCs) and boundary values for both DIN and TP are sufficient for Italy and Slovenia. Data for Bosnia and Hercegovina, Croatian and Montenegro need to be additionally validated. Greece does not report data in the ADR. Namely, for calculation of the RCs and boundary values as a minimum the following datasets need to be provided: three continuous years of monitoring with a minimum monthly frequency for Water types I and II and bimonthly to seasonal for Type III. It should also be noted that other supporting parameters (i.e., temperature, salinity and dissolved oxygen) need to be available for defining the water typology.

Albania

The table below provides the datasets for the period from 2005 to 2006 reported by Albania to the MEDPOL Database. No further datasets were received from Albania.[15]

Count of Concentration	Year		
Parameter	2005	2006	Total
Ammonium	3	3	6
Dissolved oxygen	3	3	6
Nitrate	3	3	6
Nitrate + Nitrite	3	3	6
Nitrite	3	3	6
Orthophosphate	3	3	6
Temperature (water)	3	3	6
Total phosphorus	3	3	6
Total	**24**	**24**	**48**

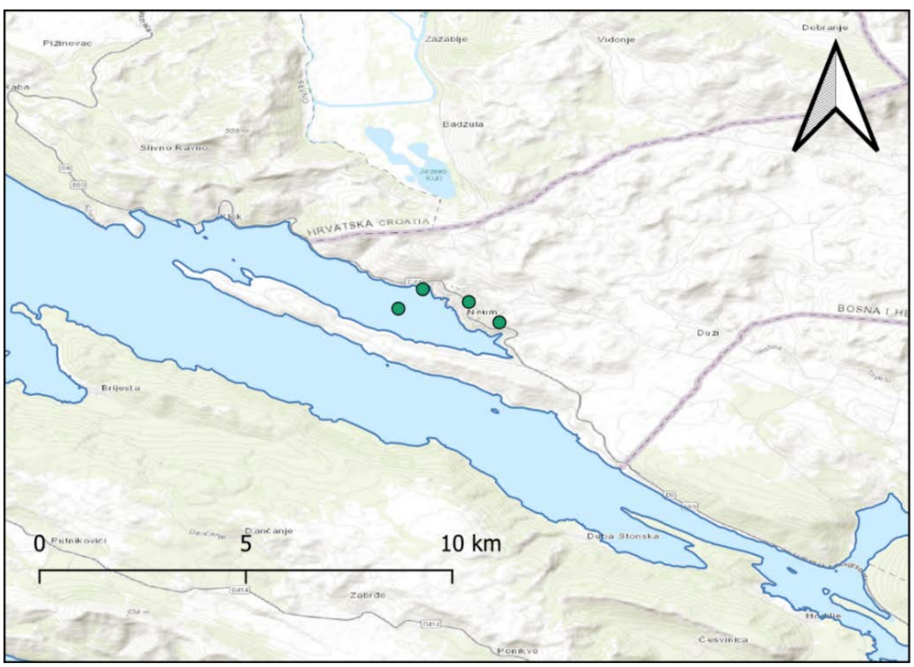


[15] Before the finalization of the present work, there was no improvement in insufficient quality of data generated at a few monitoring stations in Albania in 2019 within the GEF Adriatic Project.

Bosnia and Herzegovina

The table below provides the datasets for the period from 2013 to 2020 reported by Bosnia and Herzegovina to the IMAP Pilot Info System.

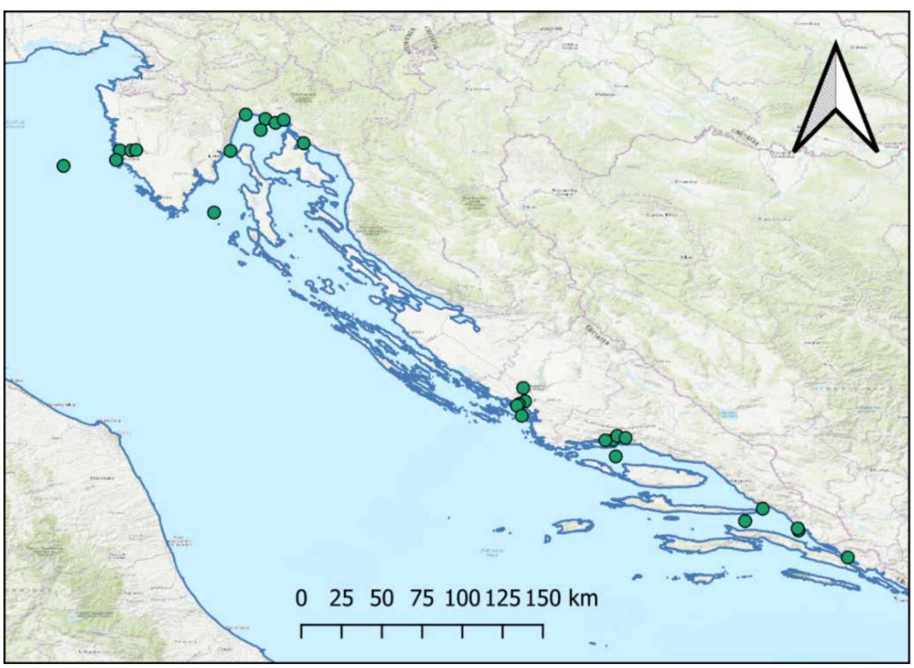
Count of Concentration	Years											
Parameter	**2006**	**2007**	**2008**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Ammonium				4	4	4	12	4	4	12	5	49
Chlorophyll a				4	4	4	12	4	4	12	5	49
Conductivity				4	4	4	12	4	4	12	5	49
Dissolved oxygen				4	4	4	12	4	4	12	5	49
Nitrate	24	28	20	4	4	4	12	4	4	12	5	121
Orthophosphate				4	4	4	12	4	4	12	5	49
Oxygen saturation				4	4	4	12	4	4	12	5	49
pH				4	4	4	12	4	4	12	5	49
Temperature (water)	24	28	20	4	4	4	12	4	4	12	5	121
Total nitrogen				4	4	4	12	4	4	12		44
Total phosphorus				4	4	4	12	4	4	12	5	49
Total	**48**	**56**	**40**	**44**	**44**	**44**	**132**	**44**	**44**	**132**	**50**	**678**



Croatia

Data of Croatia for 2009 are included in the MED POL Database as shown in the table below. Additionally, four more years of data corresponding to monitoring years 2011, 2012, 2013 and 2014 were submitted to MEDPOL. Data for the period from 2016 to 2019 were reported to the IMAP Pilot Info System.

Count of Concentration	Year									
Parameters	**2009**	**2011**	**2012**	**2013**	**2014**	**2016**	**2017**	**2018**	**2019**	**Grand Total**
Ammonium	674	1466	369	832	364	72	144	94	216	4231
Chlorophyll a	673	1472	364	794	364	71	142	92	212	4184
Dissolved oxygen	680	1524	372	842	364	72	144	94	216	4308
Nitrate	666	1485	368	842	364	72	144	94	216	4251
Nitrite	650	1499	371	832	364	72	144	94	216	4242
Orthophosphate	680	1469	336	799	325	72	144	94	216	4135
Orthosilicate	680	1500	372	842	364	72	144	94	216	4284
Oxygen saturation						72	144	93	216	525
Salinity	680	1460	373	842	364	63	132	83	203	4200
Temperature (water)	680	1584	373	842	364	63	132	83	203	4324
Total nitrogen						67	139	94	216	516
Total phosphorus	674	1440	372	842	310	72	144	94	216	4164
TRIX		642	175	378	151					1346
Grand Total	**6737**	**15541**	**3845**	**8687**	**3698**	**840**	**1697**	**1103**	**2562**	**44710**



Italy

Italy reported data for the period from 2015 to 2020 to the IMAP Pilot Info System.

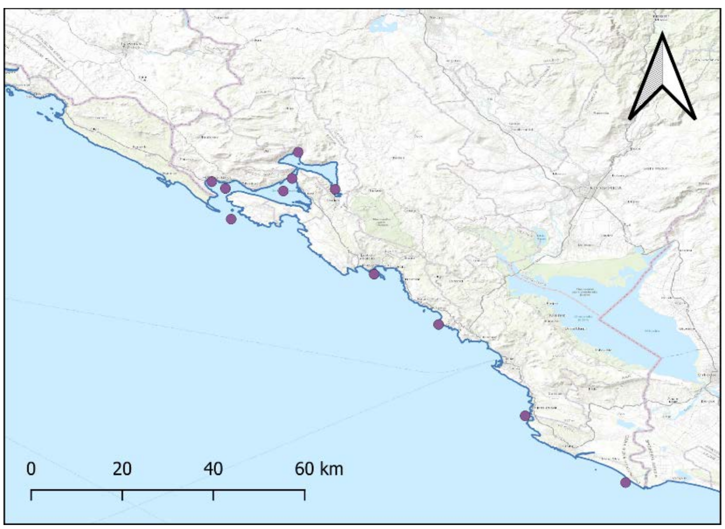
Count of Concentration	Year						
Parameter	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Grand Total**
Ammonium	330	803	783	809	729		3454
Chlorophyll a	7089	17171	15612	16669	15995	430	72966
Conductivity				16670	16020	430	33120
Dissolved oxygen	7090	17171	15631	16670	16020	430	73012
Nitrate	330	803	783	809	729		3454
Nitrite	330	803	783	809	729		3454
Orthophosphate	330	803	783	807	729		3452
Orthosilicate	330	803	783	807	728		3451
Oxygen saturation				16670	16020	430	33120
pH				16670	16020	430	33120
Salinity	7090	17180	15632	16670	16020	430	73022
Secchi disk depth	168	424	390	407	402	6	1797
Temperature (water)	7090	17180	15631	16670	16020	430	73021
Total nitrogen	324	803	777	809	729		3442
Total phosphorus	324	803	777	809	729		3442
Grand Total	**30825**	**74747**	**68365**	**122755**	**117619**	**3016**	**417327**

5

Montenegro

Data of Montenegro related to chemical pollution were included in the MED POL Database for the period until 2012, while data for the period from 2014 to 2018 were reported to MEDPOL. These data were migrated to the IMAP Pilot Info System. Data for 2019 were reported to the IMAP Pilot Info System.

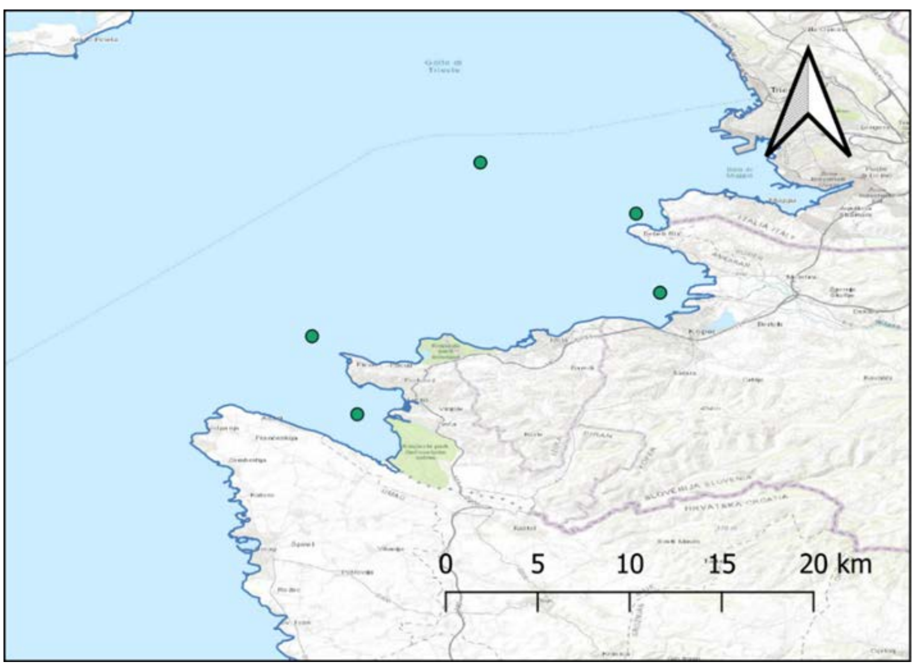
Count of Concentration	Year							
Parameters	**2012**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Grand Total**
Ammonium	30	51	183	80	82	103	116	645
Chlorophyll a	30	51	183	80	82	103	116	645
Dissolved oxygen	30	51	183	80	82	103	116	645
Nitrate	30	51	183	80	82	103	116	645
Nitrite	30	51	183	80	82	103	116	645
Orthosilicate	30	51	183	80	82	103	116	645
Oxygen saturation					46	103	116	265
Phos	30	47	170	80	82	103	116	628
Salinity	30	51	183	80	82	103	116	645
Temperature (water)	30	51	183	80	82	103	116	645
Thps	30	51	183	80	82	103	116	645
Grand Total	**300**	**506**	**1817**	**800**	**866**	**1133**	**1276**	**6698**



Slovenia

Data of Slovenia were included in the MEDPOL Database for the period until 2012, while the data for the period from 2013 to 2020 were reported to MEDPOL. These data were migrated to the IMAP Pilot Info System. The Slovenian dataset is the most complete one.

Count of Concentration	Years																			
Parameters	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Ammonium	57	48	277	233	204	107	112	7	105	108	216	93	102	202	40	99	160	184	160	2514
Chlorophyll a														101	96	99	216	222	240	974
Dissolved oxygen	57	74	276	230	204	107	124	7	105	108	216	102	102	204	128	99	288	296	240	2967
Nitrate	57	48	277	234	204	107	124	7	102	108	216	101	102	201	40	99	160	184		2371
Nitrate																			160	160
Nitrate + Nitrite						107	124													231
Nitrate + Nitrite																			160	160
Nitrite	57	48	277	234	204	107	124	7	92	108	216	99	102	202	40	99	160	184	160	2520
Orthophosphate	57	48	277	234	204	107	124	7	103	108	192	100	85	202	40	99	160	184	160	2491
Orthosilicate	17	48	265	234	204	107	124	9	106	123	214	102	102	200	40	99	160	184		2338
Oxygen saturation						89	114							102	128	99	288	296	240	1356
pH	57	48																296	240	641
Salinity	17	48						7	104	102	212	102	102	204	128	99	288	296	240	1949
Secchi disk depth																		74	60	134
Temperature (water)	74	122	277	234	204	107	124	7	105	108	216	102	102	204	128	99	288	296	240	3037
Total nitrogen	57	48	276	234	204	107	124	7	105	108	216	102	102	200	40	99	160	184	160	2533
Total phosphorus	57	48	277	234	204	107	124	7	105	108	216	102	102	202	40	99	160	184	160	2536
TRIX	45	168	204			89								100	40	99	160	182	160	1247
Total	**609**	**796**	**2683**	**2101**	**1836**	**1248**	**1342**	**72**	**1032**	**1089**	**2130**	**1005**	**1003**	**2324**	**928**	**1287**	**2648**	**3246**	**2780**	**30159**



Annex II

R scripts and outputs for the calculation of reference and boundary values for Chl*a*, TP and DIN

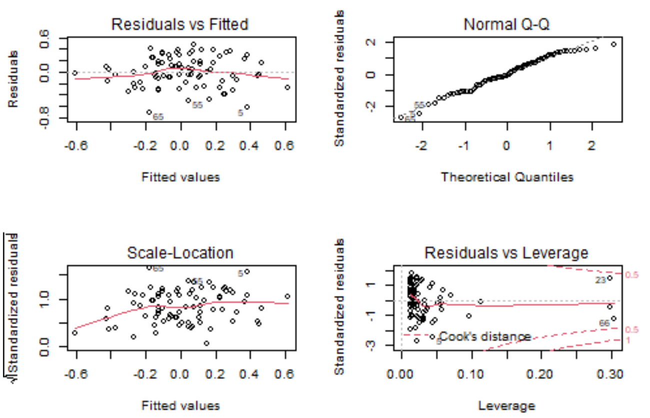
Annex II presents the Outputs of the various statistical analysis used for calculation of the reference conditions and boundary values. The code for the complete data preparation and statistical analysis is provided as follows:

A) Output of the stepwise Multiple regression;
B) The graphs summarizing the relationship between Chla and TP, and DIN as TRIX and TP, and DIN with the applied model; and
C) The code off R scripts used:
    - **MedPol_C.R** – script for data import and data preparation with the calculation of ROS estimate for BDL tagged values;
    - **Stats_2.R -** script for calculations of the Water typology and descriptive statistics (N, mean, *G_Means* etc.);
    - **Step_3**. R – script for the stepwise Multiple regression;
    - **Plot_10.R** – script for the graphs summarizing the relationship between Chla and TP, and DIN as TRIX and TP, and DIN with the applied model.

A. Stepwise Multiple regression outputs

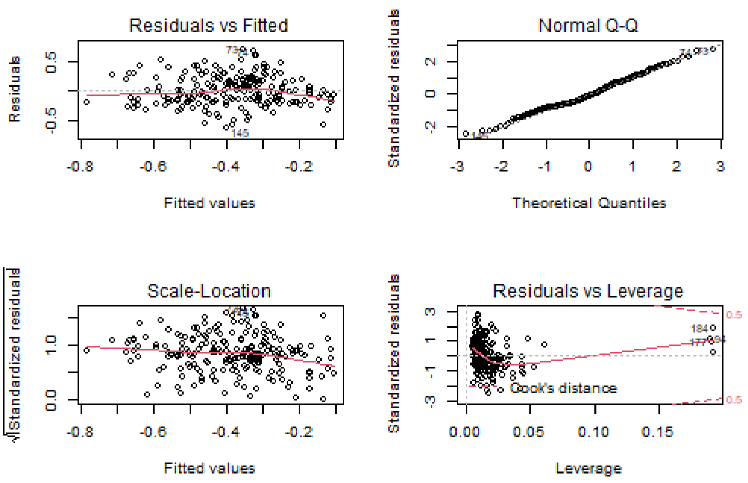
[1] "StepAIC, Type=I"

```
Start:  AIC=-212.11
LCphl ~ LTphs + LTini + LaDpO + LFDil

        Df Sum of Sq    RSS     AIC
- LFDil  1   0.00624 5.4699 -214.01
- LTphs  1   0.03738 5.5010 -213.55
<none>               5.4636 -212.10
- LaDpO  1   0.44047 5.9041 -207.75
- LTini  1   2.81718 8.2808 -180.01

Step:  AIC=-214.01
LCphl ~ LTphs + LTini + LaDpO

        Df Sum of Sq    RSS     AIC
- LTphs  1   0.03550 5.5054 -215.48
<none>               5.4699 -214.01
- LaDpO  1   0.43429 5.9042 -209.75
- LTini  1   2.84459 8.3145 -181.68

Step:  AIC=-215.48
LCphl ~ LTini + LaDpO

        Df Sum of Sq    RSS     AIC
<none>               5.5054 -215.48
- LaDpO  1    0.4389 5.9443 -211.19
- LTini  1    4.1057 9.6111 -171.79
null device
          1

Call:
lm(formula = LCphl ~ LTini + LaDpO, data = Type_I)

Residuals:
     Min       1Q   Median       3Q      Max
-0.70918 -0.17419 -0.01518  0.18599  0.47705

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.48660    0.07680  -6.336 1.35e-08 ***
LTini        0.68686    0.08949   7.676 3.72e-11 ***
LaDpO        0.13539    0.05395   2.510   0.0141 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.264 on 79 degrees of freedom
Multiple R-squared:  0.4306,	Adjusted R-squared:  0.4162
F-statistic: 29.87 on 2 and 79 DF,  p-value: 2.181e-10
```



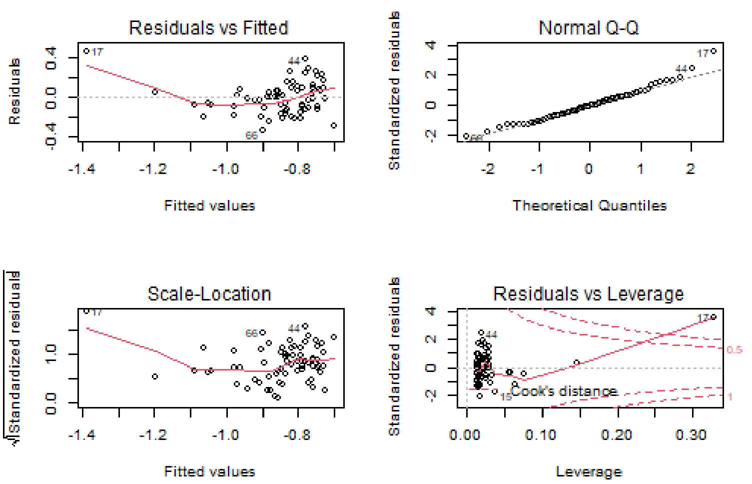
[1] "StepAIC, Type=IIA"

```
Start:  AIC=-563.06
LCphl ~ LTphs + LTini + LaDpO + LFDil
       Df Sum of Sq    RSS     AIC
- LaDpO  1   0.12072 12.877 -563.12
<none>               12.757 -563.06
- LFDil  1   0.48594 13.242 -557.36
- LTini  1   0.92595 13.682 -550.62
- LTphs  1   2.43488 15.191 -529.07
Step:  AIC=-563.12
LCphl ~ LTphs + LTini + LFDil
       Df Sum of Sq    RSS     AIC
<none>               12.877 -563.12
- LFDil  1   0.42398 13.301 -558.44
- LTini  1   0.95717 13.834 -550.35
- LTphs  1   2.52434 15.402 -528.24
null device
          1
Call:
lm(formula = LCphl ~ LTphs + LTini + LFDil, data = Type_IIA)
Residuals:
     Min       1Q   Median       3Q      Max
-0.62484 -0.17469 -0.02758  0.17551  0.69168
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.74682    0.05092 -14.667  < 2e-16 ***
LTphs       -0.36696    0.05832  -6.293  1.9e-09 ***
LTini        0.21336    0.05506   3.875 0.000144 ***
LFDil        0.10993    0.04263   2.579 0.010622 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2525 on 202 degrees of freedom
  (4 observations deleted due to missingness)
Multiple R-squared:  0.2249,	Adjusted R-squared:  0.2134
F-statistic: 19.53 on 3 and 202 DF,  p-value: 3.678e-11
```

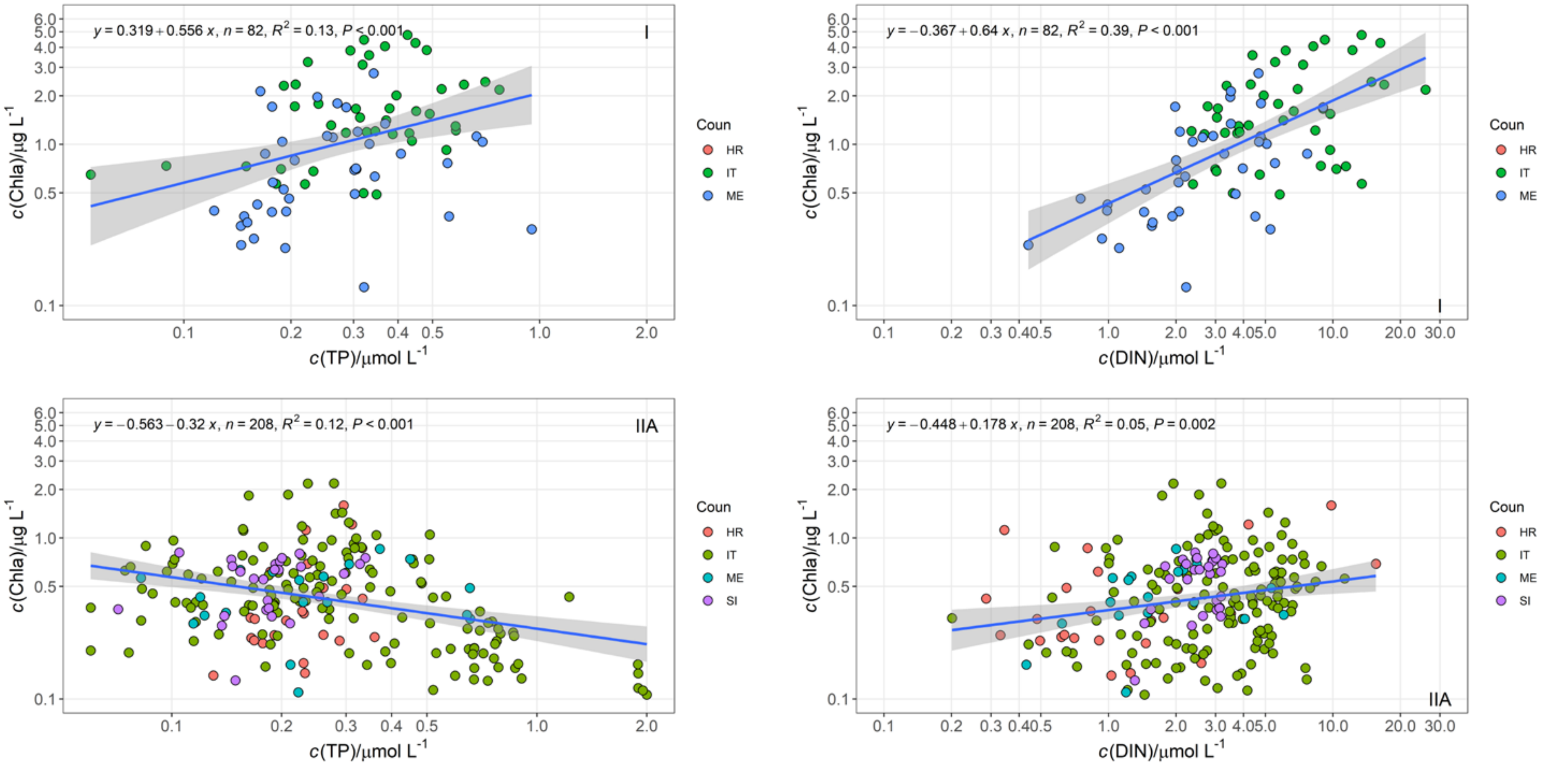


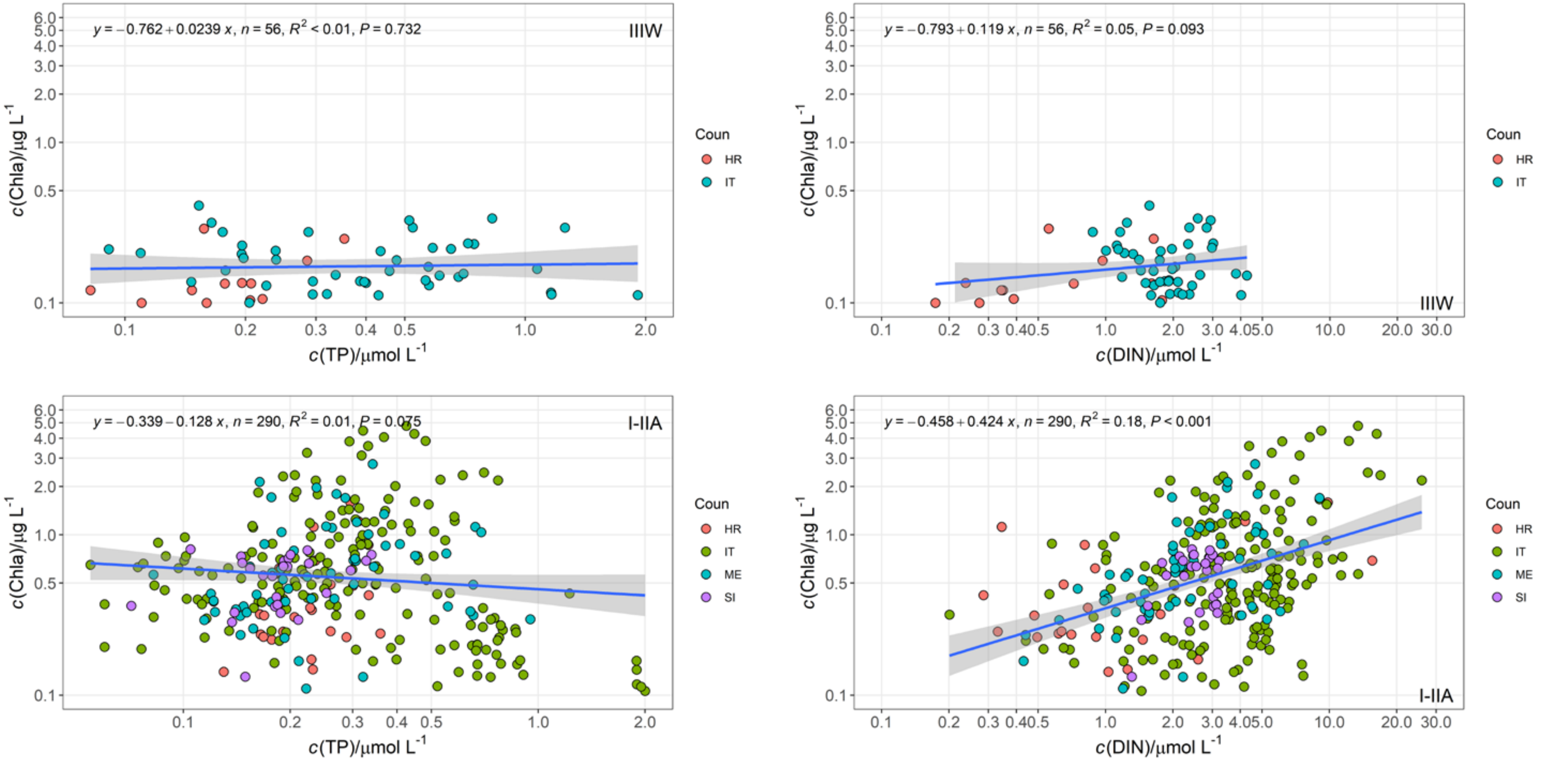
[1] "StepAIC, Type=IIIW"

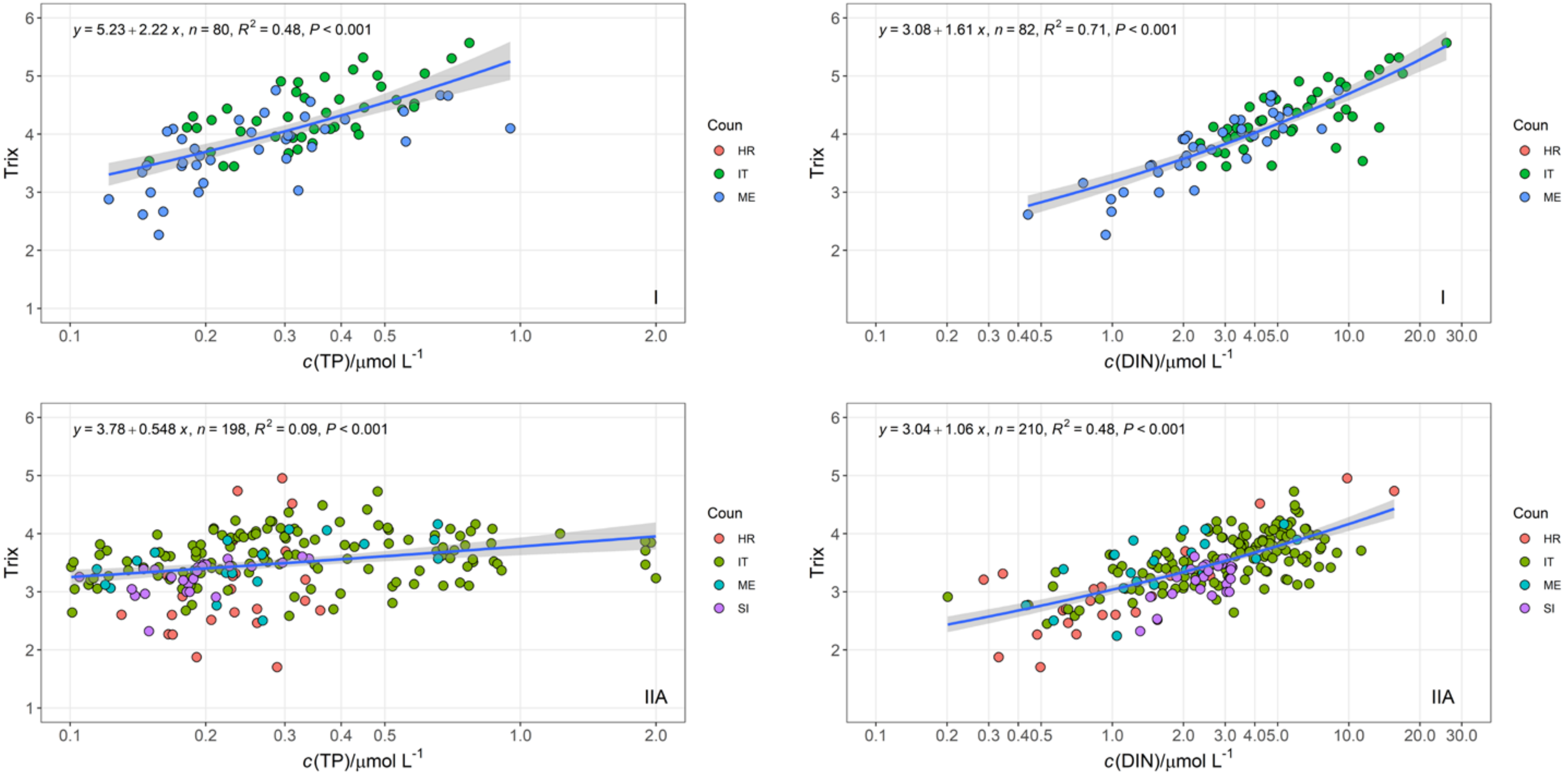
```
Start:  AIC=-244.39
LCphl ~ LTphs + LTini + LaDpO + LFDil
       Df Sum of Sq    RSS     AIC
- LTini  1   0.00318 1.6168 -246.26
- LTphs  1   0.01614 1.6298 -245.71
<none>               1.6136 -244.39
- LaDpO  1   0.04988 1.6635 -244.32
- LFDil  1   0.78675 2.4004 -219.38
Step:  AIC=-246.26
LCphl ~ LTphs + LaDpO + LFDil
       Df Sum of Sq    RSS     AIC
- LTphs  1   0.03840 1.6552 -246.66
- LaDpO  1   0.04705 1.6639 -246.31
<none>               1.6168 -246.26
- LFDil  1   0.90515 2.5219 -218.02
Step:  AIC=-246.66
LCphl ~ LaDpO + LFDil
       Df Sum of Sq    RSS     AIC
- LaDpO  1   0.04170 1.6969 -246.97
<none>               1.6552 -246.66
- LFDil  1   0.96576 2.6210 -217.41
Step:  AIC=-246.97
LCphl ~ LFDil
       Df Sum of Sq    RSS     AIC
<none>               1.6969 -246.97
- LFDil  1   0.92443 2.6213 -219.40
null device
          1
Call:
lm(formula = LCphl ~ LFDil, data = Type_IIIW)
Residuals:
     Min       1Q   Median       3Q      Max
-0.33483 -0.10883 -0.00683  0.09008  0.46550
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.87041    0.01977 -44.023  < 2e-16 ***
LFDil        0.23913    0.03988   5.996  9.4e-08 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.1603 on 66 degrees of freedom
  (5 observations deleted due to missingness)
Multiple R-squared:  0.3527,       Adjusted R-squared:  0.3428
F-statistic: 35.96 on 1 and 66 DF,  p-value: 9.402e-08
```

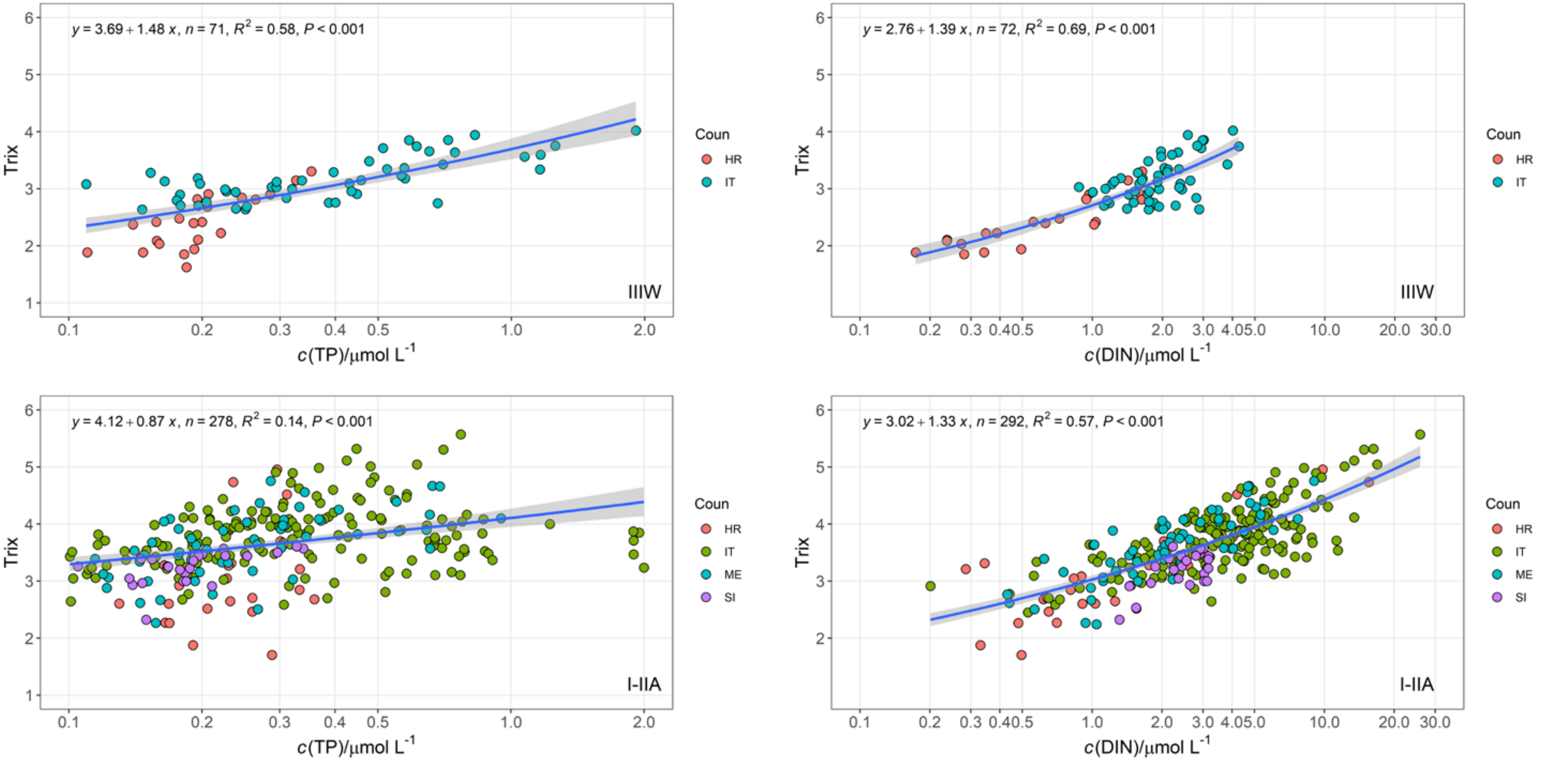


B) The graphs summarizing the relationship between Chla and TP, and DIN as TRIX and TP, and DIN with the applied model




y = −0.762 + 0.0239 x, n = 56, R2 < 0.01, P = 0.732
IIIW
c(Chla)/µg L-1
c(TP)/µmol L-1
Coun
HR
IT
y = −0.793 + 0.119 x, n = 56, R2 = 0.05, P = 0.093
IIIW
c(DIN)/µmol L-1
y = −0.339 − 0.128 x, n = 290, R2 = 0.01, P = 0.075
I-IIA
ME
SI
y = −0.458 + 0.424 x, n = 290, R2 = 0.18, P < 0.001
I-IIA


y = 5.23 + 2.22 x, n = 80, R² = 0.48, P < 0.001
y = 3.08 + 1.61 x, n = 82, R² = 0.71, P < 0.001
y = 3.78 + 0.548 x, n = 198, R² = 0.09, P < 0.001
y = 3.04 + 1.06 x, n = 210, R² = 0.48, P < 0.001
Trix
c(TP)/µmol L-1
c(DIN)/µmol L-1
I
IIA
Coun
HR
IT
ME
SI


y = 3.69 + 1.48 x, n = 71, R² = 0.58, P < 0.001
IIIW
Trix
c(TP)/µmol L⁻¹
Coun
HR
IT
y = 2.76 + 1.39 x, n = 72, R² = 0.69, P < 0.001
IIIW
c(DIN)/µmol L⁻¹
y = 4.12 + 0.87 x, n = 278, R² = 0.14, P < 0.001
I-IIA
ME
SI
y = 3.02 + 1.33 x, n = 292, R² = 0.57, P < 0.001
I-IIA

Med_POL_C.R

```
#####
#Load libraries
#####
library(readxl)
library(openxlsx)
library(plyr)
library(dplyr)
library(NADA)
library(ggplot2)
library(RColorBrewer)
library(wql)
library(shape)
library(marelac)

#####
#Import
#####
E1_ALL_H_F18 <- read_excel("Data/E1_ALL_H_F18.xlsx",
            col_types = c("text", "text", "numeric",
                  "numeric", "numeric", "text", "numeric",
                  "numeric", "numeric", "text", "numeric",
                  "numeric", "text", "numeric", "text",
                  "numeric", "text", "numeric", "numeric",
                  "numeric", "text", "numeric", "numeric",
                  "text", "numeric", "text", "numeric",
                  "numeric", "text", "numeric", "text",
                  "numeric", "numeric", "text", "numeric",
                  "text", "numeric", "numeric", "text",
                  "numeric", "text", "numeric", "numeric",
                  "text", "numeric", "text", "numeric",
                  "numeric", "text", "numeric", "numeric",
                  "text", "numeric", "numeric", "text",
                  "numeric", "numeric", "text", "text",
                  "numeric", "numeric", "text", "text",
                  "text", "text", "text"))
#View(E1_ALL_H_F18)

#####
#Attach file
#####
f<-E1_ALL_H_F18
attach(f)

#####
#Calculate 1
#####

f$ID <- seq.int(nrow(f))
f <- within(f, Osat_R <- round(((Doxy*0.031988)/oxySol(Temp, Psal)*100), 1))
f <- within(f, Osat_R <- if_else(Osat_N=="TP", Osat, Osat_R ,Osat_R))
f <- within(f, F_Dil  <- ((Psal_W-Psal)/Psal_W)*100)

#####
#CphlCen - Ros
#####

f <- mutate(f, Cphl2 = if_else(Cphl_F=="D", Cphl_D, Cphl ,Cphl))
f <- mutate(f, CphlCen = if_else(Cphl_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Cphl_N=="A",
```

```
          select=c(ID,Cphl_N, Cphl, Cphl2, CphlCen, Stat, Deph, Year))

df <- df[order(df$Cphl2),]
R = as.numeric(df$Cphl2)
RCen = as.logical(df$CphlCen)
fr <- ros(R, RCen)

df <- within(df, CphlRos <- as.numeric(fr$modeled))
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "CphlRos")], by="ID", all.x=TRUE )
dfCphl <- df

#####
#PhosCen - Ros
#####

f <- mutate(f, Phos2 = if_else(Phos_F=="D", Phos_D, Phos ,Phos))
f <- mutate(f, PhosCen = if_else(Phos_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Phos_N=="A",
          select=c(ID,Phos_N, Phos, Phos2, PhosCen, Stat, Deph, Year))

df <- df[order(df$Phos2),]
R = as.numeric(df$Phos2)
RCen = as.logical(df$PhosCen)
fr <- ros(R, RCen)

df <- within(df, PhosRos <- as.numeric(fr$modeled))
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "PhosRos")], by="ID", all.x=TRUE )
dfPhos <- df

#####
#TphsCen - Ros
#####

f <- mutate(f, Tphs2 = if_else(Tphs_F=="D", Tphs_D, Tphs ,Tphs))
f <- mutate(f, TphsCen = if_else(Tphs_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Tphs_N=="A",
          select=c(ID,Tphs_N, Tphs, Tphs2, TphsCen, Stat, Deph, Year))

df <- df[order(df$Tphs2),]
R = as.numeric(df$Tphs2)
RCen = as.logical(df$TphsCen)
fr <- ros(R, RCen)

df <- within(df, TphsRos <- as.numeric(fr$modeled))
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "TphsRos")], by="ID", all.x=TRUE )
dfTphs <- df

#####
#AmonCen - Ros
#####

f <- mutate(f, Amon2 = if_else(Amon_F=="D", Amon_D, Amon ,Amon))
f <- mutate(f, AmonCen = if_else(Amon_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Amon_N=="A",
          select=c(ID,Amon_N, Amon, Amon2, AmonCen, Stat, Deph, Year))

df <- df[order(df$Amon2),]
R = as.numeric(df$Amon2)
```

```
RCen = as.logical(df$AmonCen)
fr <- ros(R, RCen)

df <- within(df, AmonRos <- as.numeric(fr$modeled))
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "AmonRos")], by="ID", all.x=TRUE )
dfAmon <- df

#####
#NtriCen - Ros
#####

f <- mutate(f, Ntri2 = if_else(Ntri_F=="D", Ntri_D, Ntri ,Ntri))
f <- mutate(f, NtriCen = if_else(Ntri_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Ntri_N=="A",
        select=c(ID,Ntri_N, Ntri, Ntri2, NtriCen, Stat, Deph, Year))

df <- df[order(df$Ntri2),]
R = as.numeric(df$Ntri2)
RCen = as.logical(df$NtriCen)
fr <- ros(R, RCen)

df <- within(df, NtriRos <- as.numeric(fr$modeled))
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "NtriRos")], by="ID", all.x=TRUE )
dfNtri <- df

#####
#NtraCen - Ros
#####

f <- mutate(f, Ntra2 = if_else(Ntra_F=="D", Ntra_D, Ntra ,Ntra))
f <- mutate(f, NtraCen = if_else(Ntra_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Ntra_N=="A",
        select=c(ID,Ntra_N, Ntra, Ntra2, NtraCen, Stat, Deph, Year))

df <- df[order(df$Ntra2),]
R = as.numeric(df$Ntra2)
RCen = as.logical(df$NtraCen)
fr <- ros(R, RCen)

df <- within(df, NtraRos <- as.numeric(fr$modeled))
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "NtraRos")], by="ID", all.x=TRUE )
dfNtra <- df

#####
#SlcaCen - Ros
#####

f <- mutate(f, Slca2 = if_else(Slca_F=="D", Slca_D, Slca ,Slca))
f <- mutate(f, SlcaCen = if_else(Slca_F=="D", TRUE, FALSE,FALSE))

df <- subset(f, Slca_N=="A",
        select=c(ID,Slca_N, Slca, Slca2, SlcaCen, Stat, Deph, Year))

df <- df[order(df$Slca2),]
R = as.numeric(df$Slca2)
RCen = as.logical(df$SlcaCen)
fr <- ros(R, RCen)

df <- within(df, SlcaRos <- as.numeric(fr$modeled))
```

```
df <- df[order(df$ID),]
f<-merge(f, df[, c("ID", "SlcaRos")], by="ID", all.x=TRUE )
dfSlca <- df

#####
# Recalculate Tini, Trix, Efix, Napi
#####

attach(f)
f <- mutate(f, Tini = NtraRos+NtriRos+AmonRos)
f <- mutate(f, Trix = (log10(CphlRos*abs(100-(Osat_R))*(Tini*14)*(Tphs*30.97))+1.5)/1.2)
f <- mutate(f, Efix = log10((CphlRos*abs(100-(Osat_R)))/((Tini*14)*(Tphs*30.97))))
f <- mutate(f, aDpO = abs(100-(Osat_R)))
f <- mutate(f, Napi = Tini/PhosRos)

# headerStyles
hs_RP <- createStyle(fgFill = "#4F81BD", halign = "CENTER",
                textDecoration = "Bold",border = "Bottom", fontColour = "white")

l<- list("Data" = f, "Phos" = dfPhos, "Tphs" = dfTphs,  "Ntra" = dfNtra, "Ntri" = dfNtri, "Amon" = dfAmon, "Slca" = dfSlca, "Cphl" = dfCphl)
write.xlsx(l, "Data/E1_ALL_H.xlsx", firstRow = TRUE, colWidths =  "auto",  headerStyle = hs_RP )
```

Stat_3.R

```
##############################################################
# Statistics
##############################################################

library(plyr)
library(dplyr)
library(tidyr)
library(openxlsx)
library(plotrix)

##############################################################
# Type & Stats
##############################################################

attach(f)

q90 <- function(x) {quantile(x,probs=0.9)}

dfS <- subset(f,
     select=c(Coun, Stat_N, Year, Flag_A, Psal, CphlRos, F_Dil, aDpO, TphsRos, Tini, Trix))

St_un <- subset(f,
       select=c(Stat_N))

St_un <- unique(Stat_N)

##############################################################
# Type - 5 year
##############################################################

taa <- dfS %>%
  group_by(Coun,Stat_N) %>%
  summarize(N_PSAL = n(),
          GM_Psal=exp(mean(log(Psal), na.rm = TRUE)),
          Mean_PSAL = mean(Psal, na.rm = TRUE),
          Med_PSAL = median(Psal))

taa <-  mutate(taa, Type = if_else(Mean_PSAL >34 & Mean_PSAL<37.5,"IIA",""))
taa <-  mutate(taa, Type = if_else(Mean_PSAL >20 & Mean_PSAL<34,"I",Type))
taa <-  mutate(taa, Type = if_else(Mean_PSAL >37.5,"IIIW",Type))
```

```
###############################################################
# Psal - Stat, year
###############################################################

ta <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_Psal = n(),
        GM_Psal=exp(mean(log(Psal), na.rm = TRUE)),
        Mean_Psal = mean(Psal, na.rm = TRUE),
        Med_Psal = median(Psal, na.rm = TRUE),
        p90_Psal = quantile(Psal, probs=0.90, na.rm = TRUE),
        SD_Psal = sd(Psal,na.rm = TRUE),
        STE_Psal = std.error(Psal,na.rm = TRUE))

###############################################################
# Cphl - Stat, year
###############################################################

tb <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_Cphl = n(),
        GM_Cphl=exp(mean(log(CphlRos), na.rm = TRUE)),
        Mean_Cphl = mean(CphlRos, na.rm = TRUE),
        Med_Cphl = median(CphlRos, na.rm = TRUE),
        p90_Cphl = quantile(CphlRos, probs=0.90, na.rm = TRUE),
        SD_Cphl = sd(CphlRos,na.rm = TRUE),
        STE_Cphl = std.error(CphlRos,na.rm = TRUE))

###############################################################
# F_Dil - Stat, year
###############################################################

tc <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_FDil = n(),
        GM_FDil=exp(mean(log(F_Dil), na.rm = TRUE)),
        Mean_FDil = mean(F_Dil, na.rm = TRUE),
        Med_FDil = median(F_Dil, na.rm = TRUE),
        p90_FDil = quantile(F_Dil, probs=0.90, na.rm = TRUE),
        SD_FDil = sd(F_Dil,na.rm = TRUE),
        STE_FDil = std.error(F_Dil,na.rm = TRUE))

###############################################################
# aDpO - Stat, year
###############################################################

td <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_aDpO = n(),
        GM_aDpO = exp(mean(log(aDpO), na.rm = TRUE)),
        Mean_aDpO = mean(aDpO, na.rm = TRUE),
        Med_aDpO = median(aDpO, na.rm = TRUE),
        p90_aDpO = quantile(aDpO, probs=0.90, na.rm = TRUE),
        SD_aDpO = sd(aDpO,na.rm = TRUE),
        STE_aDpO = std.error(aDpO,na.rm = TRUE))

###############################################################
# Tphs - Stat, year
###############################################################

te <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_Tphs = n(),
```

```
        GM_Tphs=exp(mean(log(TphsRos), na.rm = TRUE)),
        Mean_Tphs = mean(TphsRos, na.rm = TRUE),
        Med_Tphs = median(TphsRos, na.rm = TRUE),
        p90_Tphs = quantile(TphsRos, probs=0.90, na.rm = TRUE),
        SD_Tphs = sd(TphsRos,na.rm = TRUE),
        STE_Tphs = std.error(TphsRos,na.rm = TRUE))

##############################################################
# Tini - Stat, year
##############################################################

tf <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_Tini = n(),
        GM_Tini=exp(mean(log(Tini), na.rm = TRUE)),
        Mean_Tini = mean(Tini, na.rm = TRUE),
        Med_Tini = median(Tini, na.rm = TRUE),
        p90_Tini = quantile(Tini, probs=0.90, na.rm = TRUE),
        SD_Tini = sd(Tini,na.rm = TRUE),
        STE_Tini = std.error(Tini,na.rm = TRUE))

##############################################################
# Trix - Stat, year
##############################################################

tg <- dfS %>%
  group_by(Coun,Stat_N,Year) %>%
  summarize(N_Trix = n(),
        GM_Trix=exp(mean(log(Trix), na.rm = TRUE)),
        Mean_Trix = mean(Trix, na.rm = TRUE),
        Med_Trix = median(Trix, na.rm = TRUE),
        p90_Trix = quantile(Trix, probs=0.90, na.rm = TRUE),
        SD_Trix = sd(Trix,na.rm = TRUE),
        STE_Trix = std.error(Trix,na.rm = TRUE))

##############################################################
# Merge tb&ta
##############################################################

t <- left_join(ta, tb, by = c('Coun', 'Stat_N', 'Year'))
t <- left_join(t, tc, by = c('Coun', 'Stat_N', 'Year'))
t <- left_join(t, td, by = c('Coun', 'Stat_N', 'Year'))
t <- left_join(t, te, by = c('Coun', 'Stat_N', 'Year'))
t <- left_join(t, tf, by = c('Coun', 'Stat_N', 'Year'))
t <- left_join(t, tg, by = c('Coun', 'Stat_N', 'Year'))
t <- left_join(t, select(taa, c(Coun,Stat_N,Type)), by = c('Coun','Stat_N'))

# headerStyles
hs_RP <- createStyle(fgFill = "#4F81BD", halign = "CENTER",
            textDecoration = "Bold",border = "Bottom", fontColour = "white")

l<- list("Stats" = t, "Type" = taa, "Psal" = ta, "Cphl" = tb,  "F_Dil" = tc,  "aDpO" = td,  "Tphs" = te,  "Tini" = tf)
write.xlsx(l, "Data/Stats_1.xlsx", firstRow = TRUE, colWidths =  "auto",  headerStyle = hs_RP )
```

Step_1.R

```
# Load libraries ----
library(dplyr)
library(ggplot2)
library(MASS)

#Attach file ----
attach(t)

sink("Outputs/StepAIC_Log10.txt")

# StepAIC, Type=I ----
print("StepAIC, Type=I")
x <- subset(t, Type=="I" & GM_Cphl>0,
        select=c(GM_Cphl,GM_Tphs,GM_Tini,GM_aDpO,GM_FDil))

x <- within(x, LCphl <- log10(GM_Cphl))
x <- within(x, LTphs <- log10(GM_Tphs))
x <- within(x, LTini <- log10(GM_Tini))
x <- within(x, LaDpO <- if_else(GM_aDpO == 0,log10(0.01), log10(GM_aDpO)))
x <- within(x, LFDil <- if_else(GM_FDil == 0,log10(0.01), log10(GM_FDil)))

Type_I<-x
m = lm(LCphl ~ LTphs + LTini + LaDpO + LFDil, data=Type_I)

a<-stepAIC(m)

png("Outputs/StepAIC_I.png",width = 500, height = 350)
par(mfrow=c(2,2))
plot(a)
dev.off()
#Plot your assumption graphs
summary(a)


# StepAIC, Type=IIA ----
print("StepAIC, Type=IIA")
x <- subset(t, Type=="IIA" & GM_Cphl>0,
        select=c(GM_Cphl,GM_Tphs,GM_Tini,GM_aDpO,GM_FDil))

x <- within(x, LCphl <- log10(GM_Cphl))
x <- within(x, LTphs <- log10(GM_Tphs))
x <- within(x, LTini <- log10(GM_Tini))
x <- within(x, LaDpO <- if_else(GM_aDpO == 0,log10(0.01), log10(GM_aDpO)))
x <- within(x, LFDil <- if_else(GM_FDil == 0,log10(0.01), log10(GM_FDil)))

Type_IIA<-x
m = lm(LCphl ~ LTphs + LTini + LaDpO + LFDil, data=Type_IIA)

a<-stepAIC(m)

png("Outputs/StepAIC_IIA.png",width = 500, height = 350)
par(mfrow=c(2,2))
plot(a)
dev.off()
#Plot your assumption graphs
summary(a)


# StepAIC, Type=IIIW ----
print("StepAIC, Type=IIIW")
x <- subset(t, Type=="IIIW" & GM_Cphl>0,
        select=c(GM_Cphl,GM_Tphs,GM_Tini,GM_aDpO,GM_FDil))
```

```
x <- within(x, LCphl <- log10(GM_Cphl))
x <- within(x, LTphs <- log10(GM_Tphs))
x <- within(x, LTini <- log10(GM_Tini))
x <- within(x, LaDpO <- if_else(GM_aDpO == 0,log10(0.01), log10(GM_aDpO)))
x <- within(x, LFDil <- if_else(GM_FDil == 0,log10(0.01), log10(GM_FDil)))

Type_IIIW<-x
m = lm(LCphl ~ LTphs + LTini + LaDpO + LFDil, data=Type_IIIW)

a<-stepAIC(m)

png("Outputs/StepAIC_IIIW.png",width = 500, height = 350)
par(mfrow=c(2,2))
plot(a)
dev.off()
#Plot your assumption graphs
summary(a)

sink()
```

Plot_10.R

```
# Load libraries ----
library(readxl)
library(openxlsx)
library(plyr)
library(dplyr)
library(ggplot2)
library(RColorBrewer)
library(wql)
library(shape)
library(tidyverse)
library(tidymodels)
library(ggpmisc)
library(gginnards)
library(broom)
library(quantreg)

#Attach file ----
attach(t)

#S01 Tphs,Trix-IIA,glm ----
x <- subset(t, Type=="IIA",
         select=c(GM_Tphs, GM_Trix,Coun, Type))
b_Trix<-c(1,2,3,4,5,6)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tphs, limits = c(0.1,2))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=2, y=1.2, label="IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                after_stat(n.label),
                                after_stat(rr.label),
                                after_stat(p.value.label),
                                sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S02_Thps_Trix_IIA.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S02 Tphs,Trix-IIIW,glm ----
x <- subset(t, Type=="IIIW",
         select=c(GM_Tphs, GM_Trix,Coun, Type))
b_Trix<-c(1,2,3,4,5,6)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Trix))
```

```
p2<-scale_x_log10(breaks=b_Tphs, limits = c(0.1,2))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=2, y=1.2, label="IIIW", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S03_Thps_Trix_IIIW.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S03 Tphs,Trix-I,glm ----
x <- subset(t, Type=="I",
         select=c(GM_Tphs, GM_Trix,Coun, Type))
b_Trix<-c(1,2,3,4,5,6)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tphs, limits = c(0.1,2))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=2, y=1.2, label="I", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S01_Thps_Trix_I.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S04 Tphs,Trix-I,IIA,glm ----
x <- subset(t, Type=="I" | Type=="IIA",
```

```
         select=c(GM_Tphs, GM_Trix,Coun, Type))
b_Trix<-c(1,2,3,4,5,6)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tphs, limits = c(0.1,2))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=2, y=1.2, label="I-IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S04_Thps_Trix_I-IIA.png", sep="")
ggsave(file_name,
     width = 8,
     height = 4,
     dpi = 600)

#S11 Tini,Trix-IIA,glm ----
x <- subset(t, Type=="IIA",
         select=c(GM_Tini, GM_Trix,Coun, Type))
b_Trix<-c(2,3,4,5,6)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tini, limits=c(0.1,30))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=25, y=1.2, label="IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S12_Tini_Trix_IIA.png", sep="")
ggsave(file_name,
```

```
      width = 8,
      height = 4,
      dpi = 600)

#S12 Tini,Trix-I,glm ----
x <- subset(t, Type=="I",
         select=c(GM_Tini, GM_Trix,Coun, Type))
b_Trix<-c(2,3,4,5,6)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tini, limits=c(0.1,30))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=25, y=1.2, label="I", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S11_Tini_Trix_I.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S13 Tini,Trix-I,IIA,glm ----
x <- subset(t, Type=="I" | Type=="IIA",
         select=c(GM_Tini, GM_Trix,Coun, Type))
b_Trix<-c(2,3,4,5,6)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tini, limits=c(0.1,30))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
            formula=y~x,
            method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=25, y=1.2, label="I-IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
```

```
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S14_Tini_Trix_I-IIA.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S14 Tini,Trix-IIIW,glm ----
x <- subset(t, Type=="IIIW",
          select=c(GM_Tini, GM_Trix,Coun, Type))
b_Trix<-c(2,3,4,5,6)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Trix))
p2<-scale_x_log10(breaks=b_Tini, limits=c(0.1,30))
p3<-scale_y_continuous(breaks=b_Trix, limits = c(1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="glm",
             formula=y~x,
             method.args=list(family=gaussian(link="log")))
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
         axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = "Trix")
p64<-annotate(geom="text", x=25, y=1.2, label="IIIW", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                  after_stat(n.label),
                                  after_stat(rr.label),
                                  after_stat(p.value.label),
                                  sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S13_Tini_Trix_IIIW.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)



#S21 Cphl,Tphs-IIA,lm ----
x <- subset(t, Type=="IIA",
          select=c(GM_Tphs, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tphs)
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
         axis.title=element_text(size=14))
```

```
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=2, y=5, label="IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                after_stat(n.label),
                                after_stat(rr.label),
                                after_stat(p.value.label),
                                sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S22_Thps_Chla_IIA.png", sep="")
ggsave(file_name,
     width = 8,
     height = 4,
     dpi = 600)

#S22 Cphl,Tphs-I,lm ----
x <- subset(t, Type=="I",
        select=c(GM_Tphs, GM_Cphl,Coun, Type, Year))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tphs)
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=2, y=5, label="I", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                after_stat(n.label),
                                after_stat(rr.label),
                                after_stat(p.value.label),
                                sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S21_Thps_Chla_I.png", sep="")
ggsave(file_name,
     width = 8,
     height = 4,
     dpi = 600)

#S23 Cphl,Tphs-IIIW,lm ----
x <- subset(t, Type=="IIIW",
        select=c(GM_Tphs, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tphs)
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
```

```
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
         axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=2, y=5, label="IIIW", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                          after_stat(n.label),
                                          after_stat(rr.label),
                                          after_stat(p.value.label),
                                          sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S23_Thps_Chla_IIIW.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S24 Cphl,Tphs-I_IIA,lm ----
x <- subset(t, Type=="I" |Type=="IIA",
          select=c(GM_Tphs, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tphs)
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
         axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=2, y=5, label="I-IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                          after_stat(n.label),
                                          after_stat(rr.label),
                                          after_stat(p.value.label),
                                          sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S24_Thps_Chla_I-IIA.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S25 Cphl,Tphs-I_IIA-IIIW,lm ----
x <- subset(t, Type=="I" |Type=="IIA" |Type=="IIIW",
          select=c(GM_Tphs, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tphs<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2)
x_lab=expression(paste(italic("c"), "(TP)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tphs, y=GM_Cphl))
```

```
p2<-scale_x_log10(breaks=b_Tphs)
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=2, y=5, label="All", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                    after_stat(n.label),
                                    after_stat(rr.label),
                                    after_stat(p.value.label),
                                    sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S24_Thps_Chla_All", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)


#S31 Cphl,Tini-IIA,lm ----
x <- subset(t, Type=="IIA",
          select=c(GM_Tini, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tini, limits= c(0.1,30))
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=30, y=0.1, label="IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                    after_stat(n.label),
                                    after_stat(rr.label),
                                    after_stat(p.value.label),
                                    sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S32_Tini_Chla_IIA.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S32 Cphl,Tini-I,lm ----
x <- subset(t, Type=="I",
          select=c(GM_Tini, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
```

```
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tini, limits= c(0.1,30))
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=30, y=0.1, label="I", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                     after_stat(n.label),
                                     after_stat(rr.label),
                                     after_stat(p.value.label),
                                     sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S31_Tini_Chla_I.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)

#S33 Cphl,Tini-IIIW,lm ----
x <- subset(t, Type=="IIIW",
         select=c(GM_Tini, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tini, limits= c(0.1,30))
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=30, y=0.1, label="IIIW", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                     after_stat(n.label),
                                     after_stat(rr.label),
                                     after_stat(p.value.label),
                                     sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S33_Tini_Chla_IIIW.png", sep="")
ggsave(file_name,
      width = 8,
      height = 4,
      dpi = 600)
```

```
#S34 Cphl,Tini-I-IIA,lm ----
x <- subset(t, Type=="I" | Type=="IIA",
        select=c(GM_Tini, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tini, limits= c(0.1,30))
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=30, y=0.1, label="I-IIA", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                   after_stat(n.label),
                                   after_stat(rr.label),
                                   after_stat(p.value.label),
                                   sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S34_Tini_Chla_I-IIA.png", sep="")
ggsave(file_name,
     width = 8,
     height = 4,
     dpi = 600)

#S35 Cphl,Tini-I-IIA-IIIW,lm ----
 x <- subset(t, Type=="I" | Type=="IIA" | Type=="IIIW" ,
         select=c(GM_Tini, GM_Cphl,Coun, Type))
b_Cphl<-c(0.1,0.5,1,2,3,4,5,6,10)
b_Tini<-c(0.01,0.1,0.2,0.3,0.4,0.5,1,2,3,4,5,10,20,30)
x_lab=expression(paste(italic("c"), "(DIN)/", mu, "mol L"^"-1"))
y_lab=expression(paste(italic("c"), "(Chla)/", mu, "g L"^"-1"))

p1<-ggplot(x, aes(x=GM_Tini, y=GM_Cphl))
p2<-scale_x_log10(breaks=b_Tini, limits= c(0.1,30))
p3<-scale_y_log10(breaks=b_Cphl, limits= c(0.1,6))
p4<-geom_point(aes(fill=Coun), shape=21, size=3)
p5<-geom_smooth(method="lm")
p6<-theme_bw()
p61<-theme(panel.grid.minor = element_blank())
p62<-theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14))
p63<-labs(x = x_lab, y = y_lab)
p64<-annotate(geom="text", x=30, y=0.1, label="All", color="black", size = 5 )

p7<-stat_poly_eq(parse=T, aes(label = paste(after_stat(eq.label),
                                   after_stat(n.label),
                                   after_stat(rr.label),
                                   after_stat(p.value.label),
                                   sep = "*\", \"*")))

p1+p2+p3+p4+p5+p6+p61+p62+p63+p64+p7

file_name<-paste("Figures/S34_Tini_Chla_All.png", sep="")
ggsave(file_name,
```

```
width = 8,
height = 4,
dpi = 600)
```

Annex III

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Appendix 3

The Methodology and the Results of the NEAT Tool Application for GES assessment of IMAP Common Indicator 17 in the Adriatic Sea Sub-region

1. Introduction

1. In the course of the implementation of the recommendations of the Meeting of CorMon on Pollution Monitoring (Teleconference, 26-27 April 2021) and the Meeting of the MEDPOL Focal Points (Resumed Session, 9 July 2021), related to the adjustment needed for the Meeting document UNEP/MED WG.509492/130/Rev.2[1][2][3] on Integration and Aggregation Rules for Monitoring and Assessment, the Secretariat started a testing process of the proposed methodology in the Adriatic Sea Sub-region. Therefore, the scope of the current document is to show the outcome of the testing of the proposed methodology for IMAP CI 17 in the Adriatic Sea Sub-region.

2. The harmonized application of the nested approach, including within the application of the NEAT tool, requires defining the Integration Rules for Assessments. Therefore, this document applies the definition of integration and aggregation as provided in UNEP/MED WG.492509/130/Rev.2[4]. 'Rules of Integration of Assessments' refer to the principles that underlie meaningful assessments on appropriate scales of assessment. The rules already defined for the Eutrophication, Pollution and Marine Litter Cluster in UNEP/MAP 2021 ('*4.2 Rules for integration of assessments within the nested approach'* [5]and Table 5 therein) are applied.

3. As it is indicated in several UNEP/MAP document (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.

4. The first element that needs to be considered for the implementation of the nested approach is the definition of the areas of assessment within the Adriatic Sea based on the areas of monitoring. This can be

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[1] For the purpose of building the methodology for aggregation and integration rules contained in this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes.
[2] No action or activity taken on the basis of this document shall be interpreted or considered as prejudging position of the Contracting Parties on the land or maritime sovereignty dispute or dispute concerning the delimitation of the maritime areas.
[3] Conclusion of the Meeting of MEDPOL Focal Points (Resuming session, 9 July 2021): "The Meeting reviewed Working Document UNEP/MED WG.509/10/rev.2 "Integration and Aggregation Rules for Monitoring and Assessment of IMAP Pollution and Marine Litter Cluster." The Meeting appreciated the work quality and in-depth analysis undertaken by the Secretariat to develop the proposed integration and aggregation methodology. The Meeting did not reach consensus on the document, and although some Contracting Parties (Croatia, Bosnia and Herzegovina, Montenegro, Greece) were in favor of submitting the document to the EcAP Coordination Group, the Meeting recommended that the document be returned to the CorMon for further clarifications from technical and scientific considerations with a view to avoid possible confusion with the scope/mandate of the Barcelona Convention and its Protocols. The Meeting also requested the Secretariat to include in the report of the meeting information on the reasons why the First Session of the MED POL Focal Points Meeting decided to remove document WG.509/inf14 from the list of documents."

[5] For the purpose of building the methodology for aggregation and integration rules contained in this document only the scientific elements have been considered from any reference included in this document. Legal considerations are out of the scope of the present document, which serves exclusively scientific purposes.

defined 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.

5. The harmonization of the scales approach among the concerned Contracting Parties (CPs) is the starting point for the integration process for IMAP CI 17 i.e. to scale up the marine assessment areas from the national to sub-regional and regional scales as required under IMAP. In order to support harmonization, there is a need to define Integration Rules for Monitoring Activities, which refer to a set of guidelines that should be followed when implementing monitoring programmes, in order to produce coherent data sets that will facilitate the subsequent process of providing nested GES assessments.

6. For the purposes of the present work data on contaminants produced within implementation of the national monitoring programmes of the CPs and delivered either to the IMAP Info System or to the European Marine Observation and Data Network (EMODnet) have been gathered. Information on the availability of data is given in chapter 3 below.

2. From monitoring areas to IMAP Spatial Assessment Units (IMAP SAUs) in the Adriatic Sea in line with the nested approach

7. 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 described in UNEP/MED WG.~~492~~509/10~~3~~/Rev.2, 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.

8. 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, as elaborated in UNEP/MED WG.533/Inf.5. 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 (https://www.lifewatchitaly.eu/en/related-projects/medcis-3/) 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.

9. 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 and explained above. 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. For those CPs which are EU MSs the stations positioned within the offshore zone are considered representative of a wider offshore area, as officially declared by the countries for the purposes of the MSFD implementation. For these cases the offshore IMAP SAUs are based on the MSFD MRUs.

10. 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 1.

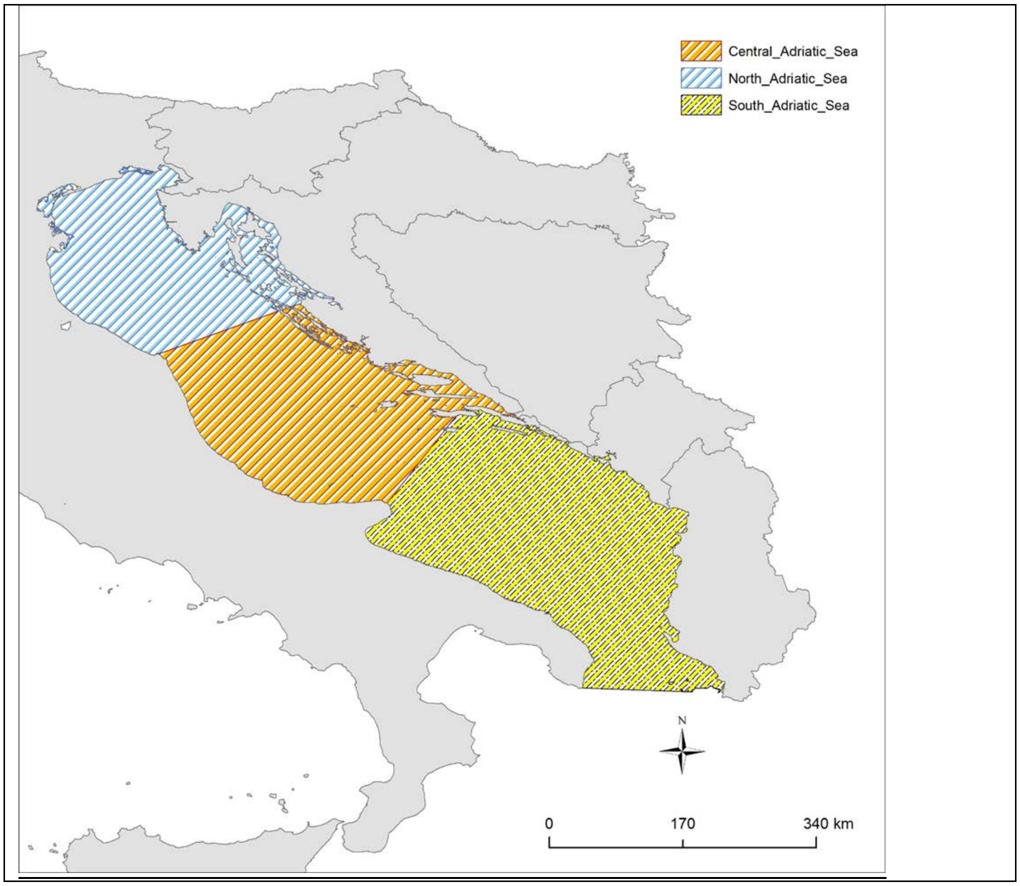


Figure 1. The 3 subdivisions of the Adriatic subregion defined based on Cushman-Roisin et al. (2001).

11. The following 4 working steps have been followed to accomplish the objectives of the current work.

12. **Step 1 Defining coastal and offshore waters**. By using the information from the MEDCIS project, it was possible to define the two zones i.e. the coastal zone and the offshore zones for the purposes of the present work in the Adriatic Sea Subregion as elaborated in UNEP/MED WG.533/Inf.5. It was found however that this MEDCIS datasets had errors for the case of Montenegro and Albania. Therefore, for these two countries data from the GEF Adriatic project were used as well as the national legislation of Albania and Montenegro (*Albania:* Degree No. 4650 of March 1970 and the Decree on a Modification to Decree No. 4650, dated 9 March 1970, on the State Border of the People's Socialist Republic of Albania, 1990; ; *Montenegro*: Decree on the Proclamation of the Law on the Sea "Official Gazette of Montenegro", No. 17/07 date on 31.12.2007, 06/08 dated on 25.01.2008, 40/11 dated on 08.08.2011). In addition, the MEDCIS data do not include any information for Greece, however the number and position of monitoring stations were pointed in the offshore waters only, as explained in detail in UNEP/MED WG.533/Inf.5.

13. **Step 2 "Recognizing scope of IMAP areas of monitoring"**: In the absence of monitoring areas reported by the CPs, the distribution of monitoring stations was investigated by considering the coordinates of their positions provided by the CPs in the IMAP Info System. Monitoring stations are

grouped under the two zones coastal and offshore defined under Step 1, following the IMAP methodology as described in UNEP/MED WG. 493/13/Rev2 for the needs of EO9, and in line with the IMAP monitoring stations` design (hotspots, coastal, offshore). This was followed by the preparation of relevant GIS layers/maps containing positions of IMAP monitoring stations on the two zones; in this way and in the absence of the areas of monitoring (i.e. monitoring transects) set by the CPs, the areas of monitoring were recognized based on distribution of the monitoring stations. As explained above, spatial coverage of the coastal waters and the offshore territorial waters is based on available data from MEDCIS and the GEF Adriatic Projects. For Greece only one monitoring station exists in South Adriatic waters at a distance 6 nm from land. In the absence of any known pollution sources in this area, for this country only the offshore monitoring area is considered.

14. **Step 3 "Setting IMAP area of assessment"**: This step included the definition of the IMAP areas of assessment (IMAP SAUs) based on the anticipated areas of monitoring. To recognize the areas of monitoring, the criteria already set for that purpose in UNEP/MED WG.509~~492~~/1~~3~~0/Rev2 were taken into consideration to the largest possible extent. Namely i) the spatial distribution of monitoring stations in relation to the sufficiency of quality-assured data as collated for NEAT application, having in mind the risk-based principle; ii) representativeness/importance of the areas of monitoring for setting of the areas of assessment; iii) in the case of Montenegro, information available regarding the presence of impacts of pressures in monitoring areas was also taken into account; to that purpose the cumulative pressures layer from GEF Adriatic Project has been used. In addition, the interrelations of the MRUs for the CPs that are EU MSs with the IMAP monitoring areas was investigated and whether these fit for their use as IMAP SAUs, following the criteria described previously. Final results are GIS layers/maps of IMAP SAUs prepared per country from the GIS layers. They also provide the positions of monitoring stations in the areas of monitoring that were recognized within present work. This was based on the equalization of the areas of monitoring with the SAUs for Albania and Montenegro, while for Slovenia, Croatia and Greece the SAUs uses to the extent possible the areas already set by the CPs. For Italy, the approach followed is slightly different because its MRUs do not fully fit the purposes of the IMAP. Details per each country separately are presented here - below.

15. **Step 4 "Nesting of the areas of assessment within application of NEAT tool"**: For the step of nesting, the areas of assessment were first classified under the 3 subdivisions of the Adriatic Sea (i.e. North, Central, South); then a nesting scheme approach was followed. The delimitation of the three Adriatic subdivisions was made according to Cushman-Roisin et al, (2001)[6] . The approach followed for the nesting of the areas is 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 & subSAUs 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 subdivision 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 subdivisions (NAS, CAS, SAS);
- 4th level provided nesting of the areas of assessment within the Adriatic Sea Sub-region.

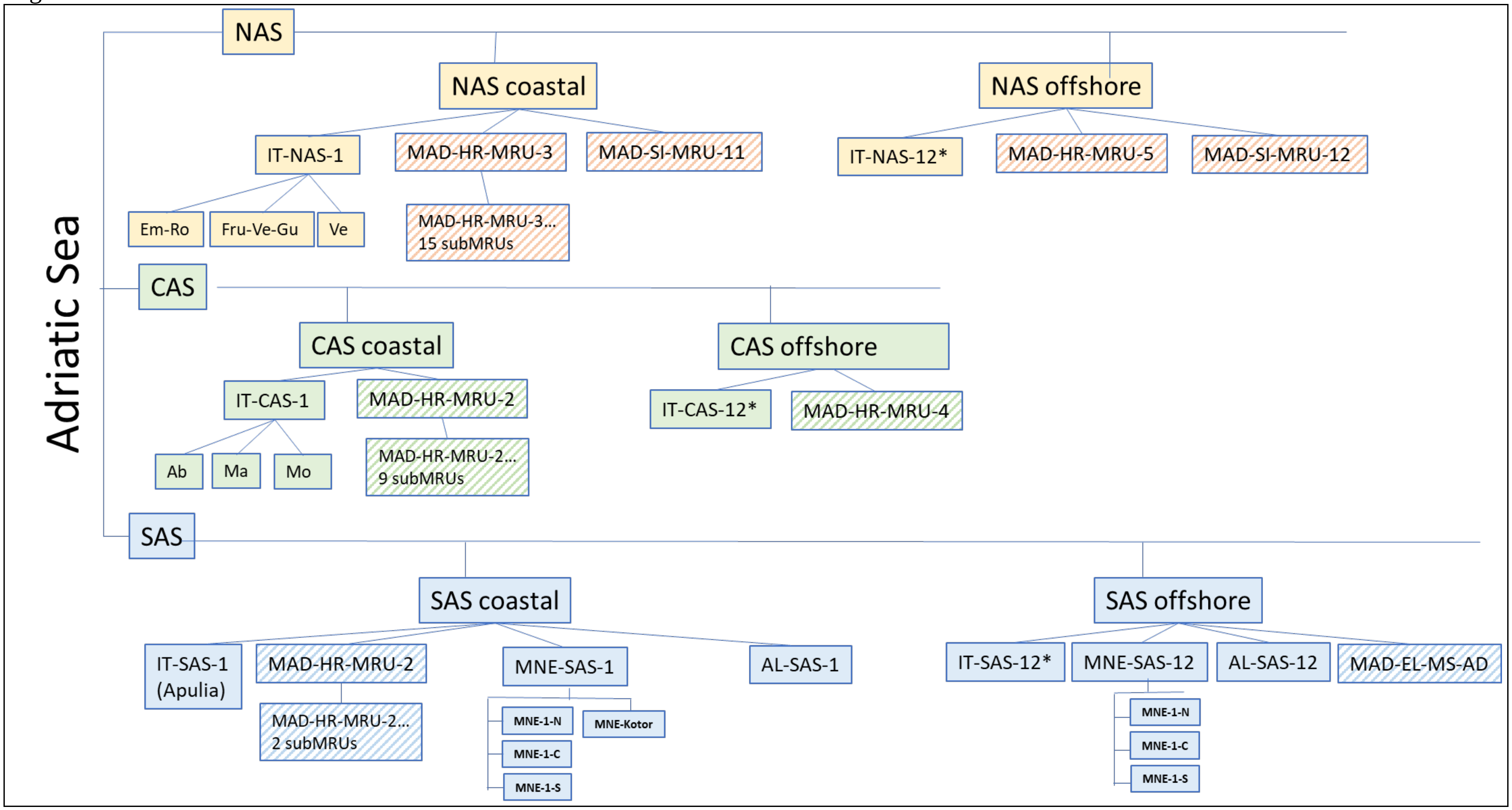
16. Similarly, the integration of the assessment results is conducted following the 4 levels nesting approach:

- 1st level: Detailed assessment results provided per subSAUs and SAUs;

[6] Cushman-Roisin, B., Gačić, M., Poulain, P-M., Artegiani, A., 2001. Physical Oceanography of the Adriatic Sea, Past, Present and Future, Springer Science + Business Media, Dordrecht, 312 pp

- 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 2. The description of the IMAP SAUs and details on specificities for each country are provided in UNEP/MED WG.533/Inf.5, while the summary is provided in Section 2.1 of UNEP/MED WG.533/Inf.4.



*For Italy the offshore IMAP SAUs areas (IT-NAS-12, IT-CAS-12, IT-SAS-12) 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 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.

17. The following maps show the nested approach per sub-divisions of the Adriatic Sea Sub-region. For each sub-division, the IMAP SAUs of every country have been selected and showed in the maps of Figures 3, 4, 5, while Table 1 in Annex I provides consolidated information of the maps for further use.

18. In North Adriatic Sea (NAS) (Figure 3), Italy has 1 offshore SAU and 3 coastal SAUs, Slovenia has 1 offshore SAU and 1 coastal SAU and Croatia has 2 offshore SAUs and 16 coastal SAUs.

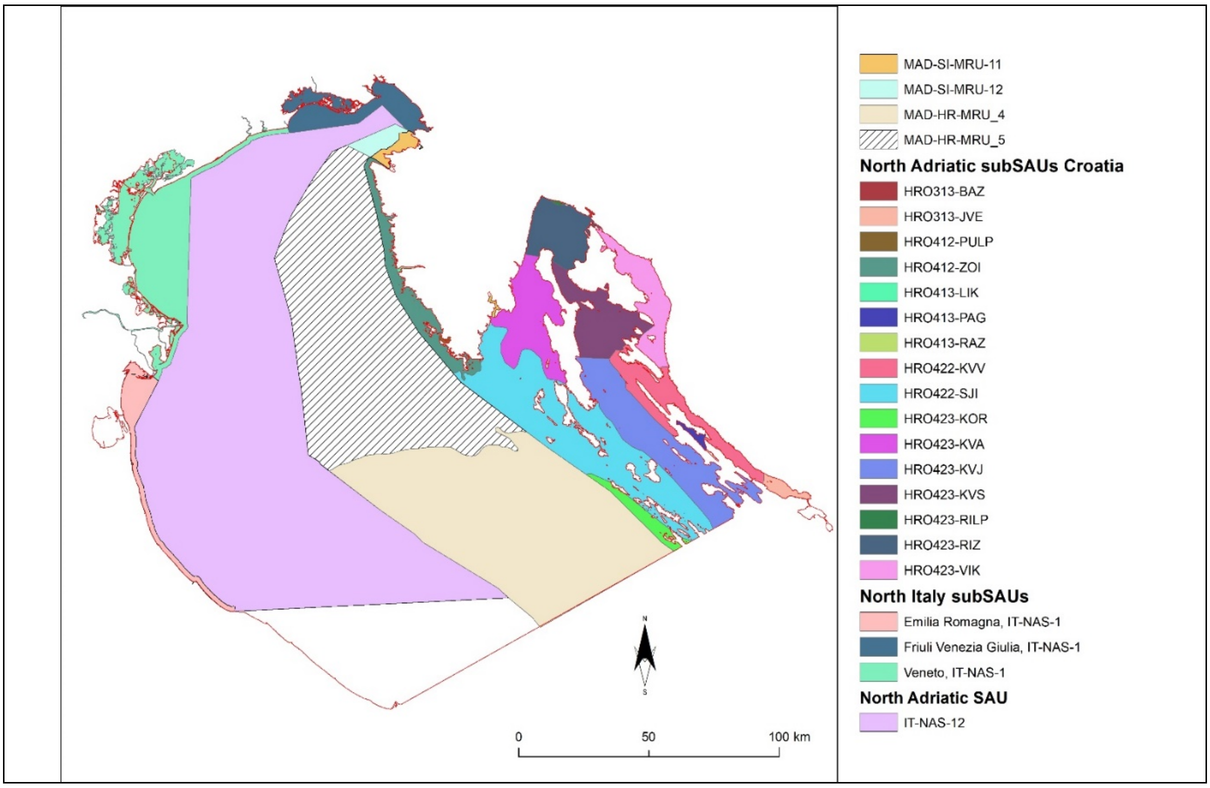


Figure 3. The nesting approach of the IMAP SAUs in North Adriatic Sea based on spatial assessment units defined for testing of NEAT application in the Adriatic Sea Sub-region.

19. In Central Adriatic Sea (CAS) (Figure 4), Italy has 1 offshore SAU and 4 coastal SAUs, Croatia has 1 offshore SAU, and 12 coastal SAUs. In Italy the offshore SAU of the Central Adriatic Sea has a shape defined by its official Central Adriatic Sea MRU as explained in the Meeting documents UNEP/MED WG.533/Inf.4 & UNEP/MED WG.533/Inf.5 , and data from monitoring stations falling into the NAS are aggregated under CAS.

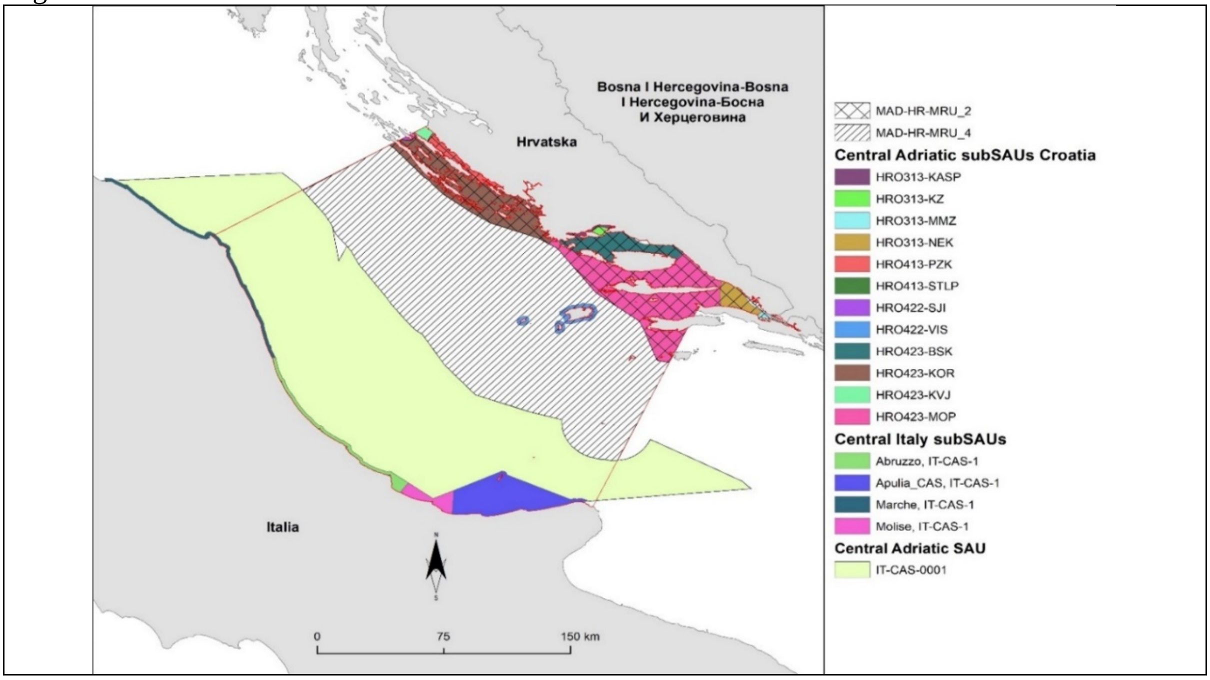


Figure 4. The nesting approach of the IMAP SAUs in Central Adriatic Sea based on the spatial assessment units defined within testing of NEAT application in the Adriatic Sea Sub-region.

20. In South Adriatic Sea (SAS) (Figure 5), Italy has 1 offshore SAU and 1 coastal SAU, Croatia has 1 offshore SAU and 2 coastal SAUs, Montenegro 3 offshore SAUs and 4 coastal SAUs, Albania has 1 offshore SAU and 1 coastal SAU and Greece 1 offshore SAU in absence of coastal stations.

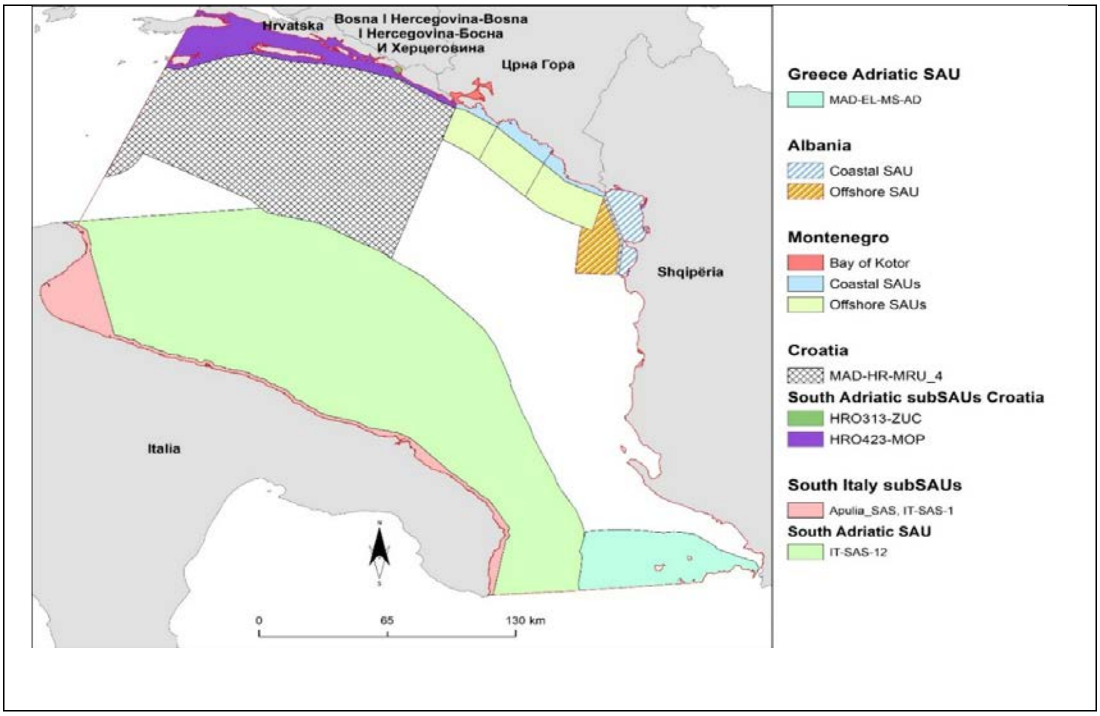


Figure 5. The nesting approach of the SAUs in South Adriatic Sea based on the spatial assessment units defined within testing of NEAT in Adriatic Sea.

3. Data availability

21. 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 2020, except from Bosnia & Herzegovina[7] 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 in Tables 2 and 3 in Annex II. 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 (184) and all SAUs have at least one station sampled once, followed by PAHs stations (99) and PCBs (49). 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 53 stations, PAHs in 16 and PCBs in 30. 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.

22. As explained above in chapter 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 1 in Annex II. 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 as provided in Tables 2 and 3 of Annex II. Table 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 3 provides 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.

4. Setting the assessment criteria

23. Upgrading of the baselines and threshold values for IMAP CI 17 in the Mediterranean Sea is an ongoing process. Detail information on their present status is provided in the present Meeting documents UNEP/MED WG.533/3 & UNEP/MED WG. 533/Inf.3 The assessment criteria used in the present assessment analysis, i.e. the GES-nonGEs boundaries are based on the MedEAC values and are defined in the Decisions IG.22/7 and IG.23/6 for contaminants. For those groups of contaminants, i.e. TM and PAHs, which occur naturally in the environment the highest assessment status is defined by using the Background assessment concentrations (BAC) and it is needed for providing sound assessment results. For the Adriatic Sea, BACs have been calculated as elaborated in UNEP/MED WG.492/12 and updated by taking into consideration more available data from the CPs in the period 2015-2019. Due to significant delay in monitoring data reporting by the CPs, the present

[7] Bosnia and Herzegovina has not been included in present GES assessment due to lack of data on contaminants as explained in the following text, however IMAP SAUs were set for B&H as explained in UNEP/MED WG. 533/ Inf 5.

implementation of the NEAT tool for the Adriatic Sea-subregion was conducted in parallel to the updating of the BCs and BACs calculation[8] and for this reason, the BAC values used in the NEAT tool are those based on data received from the CPs until August 2021, which means that there may be discrepancies for the BACs as presented in UNEP/MED WG.533/3 & UNEP/MED WG. 533/Inf.3. These differences may only affect the classification of the SAUs between the 2 status classes under GES; however, they cannot affect the classification of areas in relation to GES-non GES boundary Despite the fact that PCBs are synthetic compounds, and their BACs are expected to be zero, BACs were calculated also for PCBs in sediments and biota, to compensate for any differences in the analytical accuracy among the laboratories. BACs for PAHs in biota (mussels) were not possible to be calculated due to lack of data availability. For contaminants in fish there are no accepted GES-nonGES boundaries, and overall data for the Adriatic Sea are very limited. Further to this fact findings, the present assessment is limited to TM, PAHs, PCBs in sediments and TM, PCBs in mussels.

24. In line with the IMAP traffic light methodology, the range of concentrations equal to or below the MedEAC values correspond to the good environmental status i.e. in GES; the range of concentrations above the MedEAC values correspond to non-good environmental status i.e. non-GES. Within the GES range of concentrations, two classes are further defined the good and moderate status classes. The BAC value is used as a threshold value between them. For the nonGES range only one status class is defined, the bad status.

25. Following the methodology described in UNEP/MED WG. 493/13/Rev2 , the NEAT tool is used for the present assessment analysis. The use of NEAT tool for IMAP assessment of the GES status is compatible with the IMAP traffic light methodology but further produces two more status classes under the non-GES status. In total five status classes are set (high, good, moderate, poor, bad). The 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. 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.

26. 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. It would have been more appropriate to use for example the 90^{th} or 95^{th} percentiles of the concentration data as the upper worse boundary. However, with the exception of Hg data, for all other contaminants the 90^{th} and 95^{th} percentiles fall below the MedEAC thresholds and thus cannot be used as an upper boundary for the NEAT tool. For the GES-nonGEs threshold the MedEAC value is used. Two more threshold values were used in the present analysis: i) The BAC value to discriminate between the High -Good status, and ii) a value equal to 3 times the MedEAC to discriminate between the Moderate – Poor status. The latter has been proposed by Borja et al. (2019) to compensate for the large variation in the concentrations range, i.e. from the MedEAC value to the worse conditions limit, as is clearly the case for Hg data in sediments. By setting a nonlinear moderate-poor threshold a better discrimination of the poor status is made possible. Otherwise, areas with substantially elevated concentrations of contaminants might be classified under moderate status. For Cd and Σ_7PCBs in biota the range of measured concentrations is close to the MedEAC value, hence there is no need to assign a user defined moderate-poor threshold. Finally, the Poor -Bad threshold for all contaminants is calculated by the NEAT tool.

27. Based on these the following five status classes are produced: i) the high status referring to 0 (best conditions) < measured concentrations ≤ADR BAC range; ii) the good status referring to the ADR BAC < measured concentrations ≤ MedEAC range; iii) the moderate status referring to the MedEAC < measured concentrations ≤ 3xMedEAC range; iv) the poor and bad statuses referring to 3xMedEAC< measured concentrations ≤ Max. conc. (worse conditions) range, with bad status having

[8] UNEP/MED WG.533/3 & UNEP/MED WG. 533/Inf.3

the highest distance from the MedEAC threshold. Following the IMAP -traffic light methodology, NEAT class named ‘high’ is considered as ‘good’ *sensu* IMAP i.e. in GES; NEAT class named ‘good’ is considered as ‘moderate’ *sensu* IMAP i.e. in GES; NEAT classes named ‘moderate’ and ‘poor’ are considered as ‘Bad’ *sensu* IMAP i.e. not in GES (Table 1). The boundary/threshold values used for all the groups of contaminants in the two environmental compartments (sediments and biota) are given in Table 2.

Table 1: Relation of assessment status classes set in line with the IMAP methodology and NEAT tool and respective color coding. The position of the 2 boundary limit values and the thresholds for the NEAT tool are shown.

	GES		non-GEs		
IMAP – traffic light approach	Good	Moderate	Bad		
NEAT tool	High	Good	Moderate	Poor	Bad
	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤MedEAC	MedEAC<meas. conc. ≤ 3xMedEAC	3xMedEAC<meas. conc. ≤ max. conc.	
Boundary limits **0**					**Max. conc.**
Thresholds	**BAC**	**MedEAC**	**3xMedEAC**		

Table 2: Boundary limits of the assessment scale and class Threshold values used for the application of the NEAT tool for IMAP. The Poor/Bad threshold for all cases and the moderate/poor for Cd and Σ_7 PCBs in mussels are automatically generated by the tool (shown in italics)[9].

	Low Boundary limit	**Threshold** High/Good	**Threshold** Good/Moderate	**Threshold** Moderate/poor	**Threshold**$^{\infty}$ Poor/Bad	**Upper Boundary Limit**
Sediments	**(µg/kg)**	**ADR BAC (µg/kg)**	**MedEAC (µg/kg)**	**3 x MedEAC (µg/kg)**		**Max. conc. (µg/kg)**
Cd	0	180	1200	3600	*6300*	9000
Hg	0	75	150	450	*7725*	14200
Pb	0	23500	46700	140100	*248050*	356000
$^{*}\Sigma_{16}$ PAHs	0	197	4022	12066	*19357.5*	26649
$^{+}\Sigma_7$ PCBs	0	0.32	68	204	*319*	434
Biota (*M. galloprovincialis*)						
Cd	0	1052	5000	*5333.3*$^{\infty}$	*5666.7*	6000$^{\#}$
Hg	0	135	2500	7500	*8750*	10000

[9] Assessment based on the three nonGES categories should look for more flexibility, especially regarding biota, given the specific nature of impact of each contaminant and the criteria used in other marine areas by other Regional Seas Programmes

Pb	0	1742	7500	22500	*95192*	167884
+Σ_7 PCBs	0	25	136	*148.7*∞	*161.3*	174

∞ generated by the NEAT tool
*sum of the individual BACs or MedEACs values of the 16 PAH compounds
+ sum of the individual BACs or MedEACs values of the 7 PCB compounds
# For Cd max conc. equals 2188 (μg/kg,) lower than the MedEAC, so a value >MedEAC had to be used as the worse condition boundary limit.

28. 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.

29. 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 MEDPOL 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[10]. 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[11], the sum of the 16 EPA compounds (Σ16PAHs) and sum of the 7 PCBs compounds (Σ7PCBs) 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.

30. A data matrix to be used for the NEAT software was prepared and given below in Tables 6 – 10, Section 4 of UNEP/MED WG.533/Inf.4.

[10] 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/MED WG.533/3 & UNEP/MED WG. 533/Inf.3). 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.
[11] 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.

5. Adjusted application of the NEAT software for the assessment of IMAP Common Indicators related to Ecological Objective 9

31. 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 units and an averaging approach, allowing for specification on structural and spatial levels, applicable to any geographical scale. As explained here-below, the use of NEAT is not limited to the assessment of biodiversity but can be used for assessment of pollution impact. 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. Detailed explanation on the calculation of the weighting factors is given in Annex I.

32. 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 GES assessment of IMAP CI 17 is provided in Section 5 of UNEP/MED WG.533/Inf.4.

6. Results of the NEAT tool for the Assessment of the IMAP EO9-CI 17 status in the Adriatic Sea subregion

33. The results obtained from the NEAT tool are shown in Tables 3 and 4 below. Table 3 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 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). 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 3 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).

34. The 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 3) or per habitats (Table 4)) as expected.

35. The Tabulated NEAT results of Tables 3 and 4 are presented also schematically in Annex III herein.

36. The detailed status assessment results per contaminant show that most SAUs achieve GES conditions (high, good status) indicated by the blue and green cells in Table 3. For Hg in sediments however, some of the SAUs are found in non-GES status (yellow, brown) as follows: i) in the North Adriatic Sea, zone NAS-1, SAUs, HRO-0313-BAZ and HRO-0412-PULP in Croatia; 'Fruili-Venezia-Giulia-1' and 'Veneto-1' in Italy and in zone NAS-12, IT-NAS-12; ii) in the Central Adriatic Sea, zone CAS-1, SAUs, HRO-0313-KASP, HRO-0313-KZ, HRO-0413-STLP; iii) in the Southern Adriatic Sea, non- GES status is related to Hg in sediments of the zone SAS-1, SAUs MNE-1-C and MNE-Kotor, AL-1 and for the zone SAS-12, SAU AL-12. Regarding Pb concentrations in sediments a smaller number of SAUs is found in non-GES status: i) in the North Adriatic, zone NAS-1, SAUs, HRO-0313-BAZ and HRO-0412-PULP in Croatia and ii) in the South Adriatic, zone SAS-1, SAUs MNE-1-C and MNE-Kotor. For the organic contaminants the SAUs of Montenegro MNE-1-C and MNE-Kotor in the Southern Adriatic Sea, zone SAS-1, do not achieve GES status regarding Σ_{16}PAHs and MNE-1-S, MNE-Kotor regarding Σ_7PCBs.

37. Even though some of the Adriatic SAUs are found in non- GES conditions especially regarding Hg in sediments, mussels do not seem to be affected in the same extent. Only SAUs HRO-0413-PZK in the zone CAS-1 and MNE-1-C in the zone SAS-1 are found in non-GES regarding Pb in mussels. Finally, an extreme value of Σ_7PCBs in the SAU HRO-0313-KASP in CAS leads to bad status (red). However, the assessment status results for Σ_7PCBs in mussels are based on only one measurement per SAU and should not be considered as truly representative. More data are needed so that the assessment results can be considered more robust.

38. 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 3. It is clear that the above described non-GES classifications, do not affect the overall chemical status and all SAUs fall under the GES status (high, good) with the exception of SAU HRO-0412-PULP in Croatia, zone NAS-1, which is classified under non GES- moderate status.

39. Similarly, the aggregation-integration within the nested scheme results in GES status for the Adriatic subregion, its sub-divisions (NAS, CAS, SAS) and relevant IMAP assessment zones (NAS-1, NAS-12, CAS-1, CAS-12, SAS-1, SAS-12) (bold lines in Table 11). Within the GES status most SAUs are further classified under the high-status class. Only the zone NAS -12 is classified under good status, and this affects also the classification of the NAS subdivision (good).

40. In Table 12 the NEAT assessment results are aggregated per habitat (sediments, mussels). It is apparent that the sediments of the two SAUs HRO-0412-PULP in zone NAS-1 and MNE-Kotor in zone SAS-1 are classified under non GES, moderate status. All other cases are classified under GES (high, good status).

41. Overall, it can be seen from the Tables and schematic diagrams, that TM in sediments have the largest spatial coverage with 47 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 subdivision 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 26 out of the 49 SAUs, based on data delivered by Croatia, Italy (only for Hg in 3 SAUs), Slovenia (only in the coastal SAUs), 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.

42. The integrated results for the higher spatial units (NAS, CAS, SAS), shown in bold, and the overall assessment for EO9/CI 17 (NEAT value) show a high or good status. However, 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 3 and 4 and Annex III) can only be considered as an example of how the tool works (4th and 3rd nesting levels). This is related to the fact that several SAUs either lack data (blank cells in Tables 3 and 4, and blank boxes in Annex III). The assessment per SAU 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[12].

[12] Given lack of data for some SAUs, integration at a higher level that also includes these SAUs makes the uncertainty high.

Table 3. 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 described in 6.1.

			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**	**0.839**	**high**	**100**	**0.856**	**0.822**	**0.881**	**0.929**	**0.819**	**0.835**	**0.785**	**0.805**	**0.780**
Northern Adriatic Sea	**31856**	**0**	**0.786**	**good**	**99.9**	**0.849**	**0.536**	**0.836**	**0.910**	**0.795**	**0.836**	**0.791**	**0.848**	**0.814**
NAS-1	**9069**	**0**	**0.815**	**high**	100	**0.855**	**0.722**	**0.832**	**0.797**	**0.790**	**0.836**	**0.853**	**0.848**	**0.814**
MAD-HR-MRU-3	6422	0	0.856	high	100	0.892	0.891	0.840			0.836	0.854	0.847	0.814
HRO-0313-JVE	73	0.001	0.807	high	93.8	0.853	0.872	0.755			0.800	0.795	0.797	0.759
HRO-0313-BAZ	4	0	0.619	good	100	0.790	0.475	0.591						
HRO-0412-PULP	7	0	0.569	moderate	100	0.803	0.330	0.572						
HRO-0412-ZOI	473	0.003	0.879	high	100	0.894	0.861	0.874			0.901	0.880	0.878	0.864
HRO-0413-LIK	7	0	0.825	high	100	0.886	0.781	0.710			0.862	0.840	0.871	0.856
HRO-0413-PAG	30	0	0.828	high	100	0.832	0.837	0.780			0.856	0.877	0.840	0.786
HRO-0413-RAZ	10	0	0.835	high	100	0.852	0.883	0.770						
HRO-0422-KVV	494	0.004	0.841	high	100	0.867	0.915	0.849			0.826	0.800	0.814	0.782
HRO-0422-SJI	1923	0.014	0.881	high	100	0.916	0.944	0.906			0.843	0.879	0.842	0.796
HRO-0423-KVA	686	0.005	0.865	high	100	0.879	0.893	0.817			0.863	0.874	0.882	0.848
HRO-0423-KVJ	1089	0.008	0.852	high	100	0.888	0.907	0.795			0.800	0.862	0.922	0.777
HRO-0423-KVS	577	0.004	0.846	high	100	0.903	0.853	0.847			0.848	0.828	0.796	
HRO-0423-RILP	6	0	0.707	good	100	0.728	0.712	0.682						
HRO-0423-RIZ	475	0.003	0.818	high	100	0.877	0.861	0.763			0.802	0.799	0.791	0.816
HRO-0423-VIK	455	0.003	0.818	high	75.2	0.869	0.749	0.768			0.814	0.841	0.798	0.912
IT-NAS-1	2592	0	0.712	good	100	0.789	0.416	0.819	0.797	0.790				

			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**
IT-Em-Ro-1	371	0.003	0.796	good	62.5	0.801	0.723	0.869	0.798	0.789				
IT-Fr-Ve-Gi-1	575	0.004	0.623	good	99.7	0.843	0.315	0.712						
IT-Ve-1	1646	0.012	0.723	good	100	0.755	0.406	0.870	0.796	0.791				
MAD-SI-MRU-11	55	0	0.840	high	100	0.889		0.762	0.812		0.886	0.799	0.895	
NAS-12	**22788**	**0**	**0.774**	**good**	**100**	**0.844**	**0.400**	**0.840**	**0.930**	**0.796**		**0.786**		
MAD-HR-MRU-5	5571	0												
IT-NAS-12	10540	0.163	0.774	good	100	0.844	0.400	0.840	0.930	0.796		0.786		
MAD-SI-MRU-12	129	0												
Central Adriatic	**63696**	**0**	**0.843**	**high**	**100**	**0.850**	**0.861**	**0.893**	**0.981**		**0.856**	**0.768**	**0.788**	**0.741**
CAS-1	**9394**	**0**	**0.856**	**high**	**100**	**0.843**	**0.881**	**0.876**	**0.981**		**0.856**	**0.853**	**0.788**	**0.741**
MAD-HR-MRU-2	7302	0	0.853	high	89.9	0.855	0.900	0.848			0.856	0.853	0.788	0.741
HRO-0313-NEK	253	0.003	0.831	high	100	0.799	0.824	0.744			0.873	0.887	0.899	0.832
HRO-0313-KASP	44	0	0.637	good	100	0.793	0.400	0.742			0.888	0.799	0.811	0.016
HRO-0313-KZ	34	0	0.684	good	100	0.816	0.427	0.810						
HRO-0313-MMZ	55	0.001	0.833	high	100	0.837	0.896	0.794			0.846	0.846	0.808	0.795
HRO-0413-PZK	196	0.002	0.762	good	64.9	0.887	0.768	0.783			0.860	0.868	0.400	0.723
HRO-0413-STLP	1	0	0.698	good	100	0.798	0.477	0.820						
HRO-0423-BSK	613	0.006	0.813	high	90.2	0.800	0.752	0.796			0.829	0.849	0.831	0.864
HRO-0423-KOR	1564	0.016	0.846	high	100	0.886	0.893	0.888			0.863	0.849	0.799	0.699
HRO-0423-MOP	2480	0.025	0.883	high	100	0.854	0.941	0.852						
IT-CAS-1	2092	0	0.870	high	100	0.815	0.786	0.940	0.981					
IT-Ab-1	282	0.005	0.897	high	100	0.809	0.867	0.932	0.981					
IT-Ma-1	319	0.006	0.870	high	100	0.793		0.947						
IT-Mo-1	229	0.004	0.837	high	89.9	0.864	0.712	0.934						

			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**
CAS-12	**54303**	**0**	**0.840**	**high**	**100**	**0.851**	**0.858**	**0.896**				**0.765**		
MAD-HR-MRU-4	18963	0.178	0.897	high	100	0.887	0.909	0.894						
IT-CAS-12	22393	0.21	0.793	good	65.9	0.791	0.771	0.899				0.765		
Southern Adriatic Sea	**44231**	**0**	**0.872**	**high**	**100**	**0.866**	**0.865**	**0.881**	**0.955**	**0.922**	**0.815**	**0.910**	**0.760**	**0.770**
SAS-1	**7276**	**0**	**0.833**	**high**	**100**	**0.847**	**0.804**	**0.837**	**0.681**	**0.810**	**0.815**	**0.910**	**0.760**	**0.770**
MAD-HR-MRU-2	4252	0	0.809	high	100	0.849	0.877	0.766			0.810	0.809	0.775	0.756
HRO-0313-ZUC	13	0	0.841	high	100	0.843	0.888	0.903			0.807	0.867	0.799	0.748
HRO-0423-MOP	1756	0.031	0.809	high	89.4	0.849	0.877	0.765			0.810	0.809	0.775	0.756
IT-SAS-1 (Ap-1)	1810	0.013	0.934	high	100	0.804	0.944	0.943				0.970		
MNE-SAS-1	483	0	0.776	good	83.4	0.781	0.681	0.726	0.681	0.810	0.865	0.892	0.603	0.920
MNE-1-N	86	0.001	0.865	high	100	0.797	0.944	0.961	0.740	0.869				
MNE-1-C	246	0.002	0.704	good	97	0.772	0.569	0.572	0.773	0.795	0.787	0.846	0.324	0.888
MNE-1-S	151	0.001	0.895	high	100	0.852	0.861	0.931	0.583	0.799	0.987	0.978	0.981	0.990
MNE-Kotor	85	0.001	0.683	good	100	0.663	0.354	0.508	0.514	0.578	0.873	0.873	0.740	0.888
AL-SAS-1	646	0.005	0.752	good	89.1	0.917	0.395	0.943						
SAS-12	**36955**	**0**	**0.880**	**high**	**100**	**0.868**	**0.872**	**0.886**	**0.964**	**0.938**				
IT-SAS-12	22715	0.216	0.876	high	100	0.861	0.877	0.891						
MNE-SAS-12	2076	0	0.904	high	100	0.881	0.933	0.791	0.978	0.938				
MNE-12-N	513	0.005	0.917	high	100	0.894	0.949	0.826	0.970	0.944				
MNE-12-C	713	0.007	0.907	high	100	0.886	0.941	0.809	0.982	0.919				
MNE-12-S	849	0.008	0.894	high	100	0.869	0.917	0.755	0.980	0.950				
AL-SAS-12	716	0.007	0.809	high	59.1	0.924	0.587	0.915						
MAD-EL-MS-AD	2253	0.021	0.918	high	100	0.914		0.884	0.956					

Table 4: 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 described in 6.1.

SAU	Area (km^2)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
Adriatic Sea	**139783**	**0**	**0.839**	**high**	**100**	**0.856**	**0.789**
Northern Adriatic Sea	**31856**	**0**	**0.786**	**good**	**99.9**	**0.775**	**0.798**
NAS-1	**9069**	**0**	**0.815**	**high**	**100**	**0.802**	**0.839**
MAD-HR-MRU-3	6422	0	0.856	high	100	0.874	0.838
HRO-0313-JVE	73	0.001	0.807	high	94.2	0.827	0.788
HRO-0313-BAZ	4	0	0.619	good	100	0.619	
HRO-0412-PULP	7	0	0.569	moderate	100	0.569	
HRO-0412-ZOI	473	0.003	0.879	high	100	0.877	0.881
HRO-0413-LIK	7	0	0.825	high	100	0.792	0.857
HRO-0413-PAG	30	0	0.828	high	100	0.817	0.84
HRO-0413-RAZ	10	0	0.835	high	100	0.835	
HRO-0422-KVV	494	0.004	0.841	high	100	0.877	0.805
HRO-0422-SJI	1923	0.014	0.881	high	100	0.922	0.84
HRO-0423-KVA	686	0.005	0.865	high	100	0.863	0.867
HRO-0423-KVJ	1089	0.008	0.852	high	100	0.863	0.84
HRO-0423-KVS	577	0.004	0.846	high	100	0.868	0.824
HRO-0423-RILP	6	0	0.707	good	100	0.707	
HRO-0423-RIZ	475	0.003	0.818	high	100	0.834	0.802
HRO-0423-VIK	455	0.003	0.818	high	77.7	0.795	0.841
IT-NAS-1	**2592**	0	0.712	good	100	0.712	
IT-Em-Ro-1	371	0.003	0.796	good	62.1	0.796	
IT-Fr-Ve-Gi-1	575	0.004	0.623	good	99.6	0.623	

SAU	**Area (km²)**	**Total SAU weight factor**	**NEAT value**	**Status Class**	**% Confidence**	**sediments**	**mussels**
IT-Ve-1	1646	0.012	0.723	good	100	0.723	
MAD-SI-MRU-11	55	0	0.84	high	100	0.821	0.86
NAS-12	22788	**0**	**0.774**	**good**	100	**0.762**	**0.786**
MAD-HR-MRU-5	5571	0					
IT-NAS-12	**10540**	0.163	0.774	good	100	0.762	0.786
MAD-SI-MRU-12	129	0					
Central Adriatic	**63696**	0	0.843	high	100	0.868	0.771
CAS-1	**9394**	**0**	**0.856**	**high**	100	**0.868**	**0.809**
MAD-HR-MRU-2	7302	0	0.853	high	88.7	0.868	0.809
HRO-0313-NEK	253	0.003	0.831	high	100	0.789	0.873
HRO-0313-KASP	44	0	0.637	good	100	0.645	0.629
HRO-0313-KZ	34	0	0.684	good	100	0.684	
HRO-0313-MMZ	55	0.001	0.833	high	100	0.842	0.824
HRO-0413-PZK	196	0.002	0.762	good	63.6	0.812	0.712
HRO-0413-STLP	1	0	0.698	good	100	0.698	
HRO-0423-BSK	613	0.006	0.813	high	89.2	0.783	0.843
HRO-0423-KOR	1564	0.016	0.846	high	100	0.889	0.803
HRO-0423-MOP	2480	0.025	0.883	high	100	0.883	
IT-CAS-1	2092	0	0.87	high	100	0.87	
IT-Ab-1	282	0.005	0.897	high	100	0.897	
IT-Ma-1	319	0.006	0.87	high	100	0.87	
IT-Mo-1	229	0.004	0.837	high	86.8	0.837	
CAS-12	**54303**	**0**	**0.84**	**high**	**100**	**0.868**	**0.765**
MAD-HR-MRU-4	18963	0.178	0.897	high	100	0.897	
IT-CAS-12	22393	0.21	0.793	good	61.7	0.82	0.765

SAU	Area (km²)	Total SAU weight factor	NEAT value	Status Class	% Confidence	sediments	mussels
Southern Adriatic Sea	**44231**	**0**	**0.872**	**high**	**100**	**0.875**	**0.841**
SAS-1	**7276**	**0**	**0.833**	**high**	**100**	**0.827**	**0.841**
MAD-HR-MRU-2	4252	0	0.809	high	100	0.831	0.788
HRO-0313-ZUC	13	0	0.841	high	100	0.878	0.805
HRO-0423-MOP	1756	0.031	0.809	high	87.7	0.831	0.788
IT-SAS-1 (Ap-1)	1810	0.013	0.934	high	100	0.897	0.97
MNE-SAS-1	483	0	0.776	good	84	0.724	0.82
MNE-1-N	86	0.001	0.865	high	100	0.861	
MNE-1-C	246	0.002	0.704	good	96.8	0.696	0.711
MNE-1-S	151	0.001	0.895	high	100	0.805	0.984
MNE-Kotor	85	0.001	0.683	good	100	0.523	0.843
AL-SAS-1	646	0.005	0.752	good	92.4	0.752	
SAS-12	**36955**	**0**	**0.88**	**high**	**100**	**0.88**	
IT-SAS-12	22715	0.216	0.876	high	100	0.876	
MNE-SAS-12	2076	0	0.904	high	100	0.904	
MNE-12-N	513	0.005	0.917	high	100	0.917	
MNE-12-C	713	0.007	0.907	high	100	0.907	
MNE-12-S	849	0.008	0.894	high	100	0.894	
AL-SAS-12	716	0.007	0.809	high	60	0.809	
MAD-EL-MS-AD	2253	0.021	0.918	high	100	0.918	

43. 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 3, are visualized in the schematic diagrams provided in Annex III. Also, the final GES assessment findings for all the IMAP SAUs in the Adriatic Sea, as provided in Table 3 are shown by the respective color in the maps included in the following Figures 6-8. The maps depict the integrated NEAT value for each SAU (i.e. aggregated value for all contaminants as provided in the 4th column of Table 3).

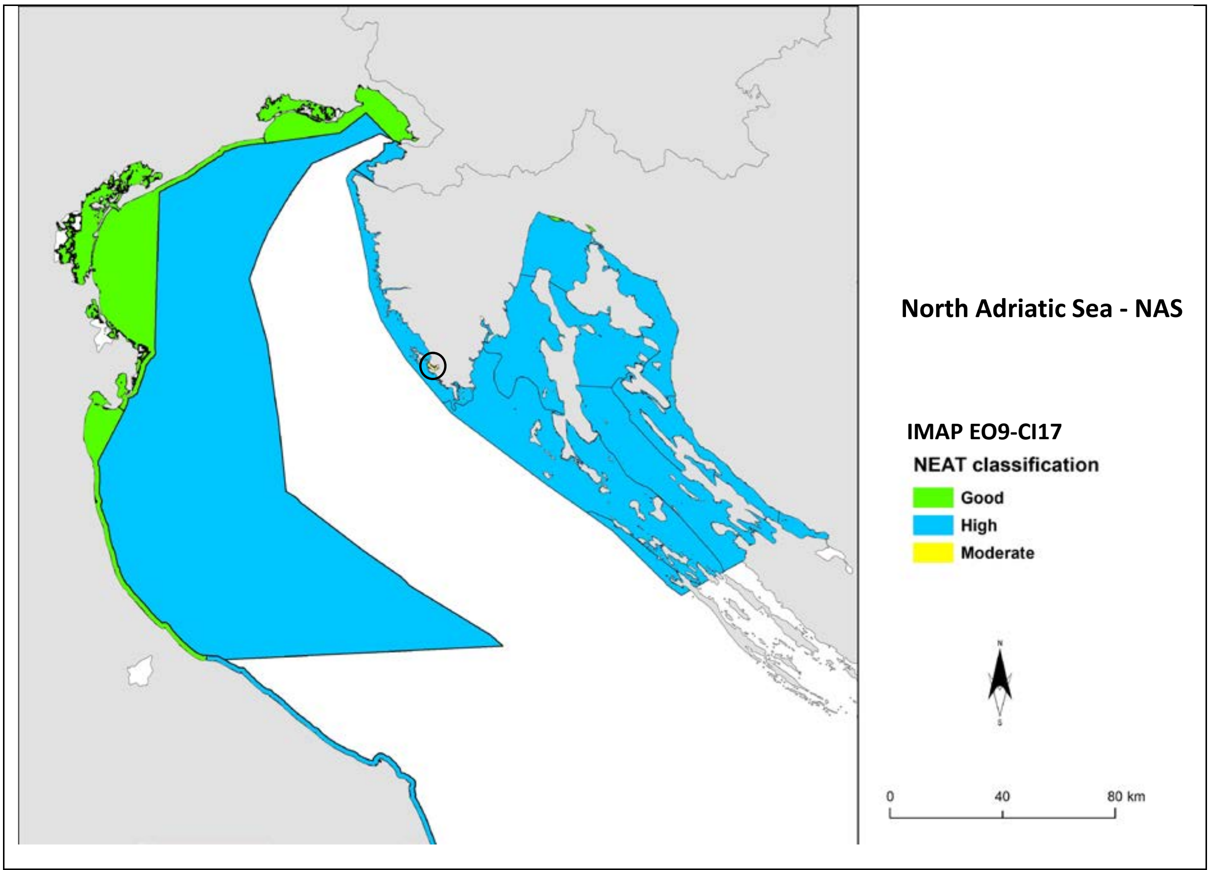


Figure 6: The NEAT assessment results for IMAP CI17 in the North Adriatic Sea. All IMAP SAUs are in GES characterized by High or Good status. Only Sub-SAU HRO-0412-PULP (denoted with circle) is found under nonGES-moderate status. Blank area corresponds to no available data.

44. The overall status of CI17 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. Only one small sub-SAU is classified under moderate status and not in GES.

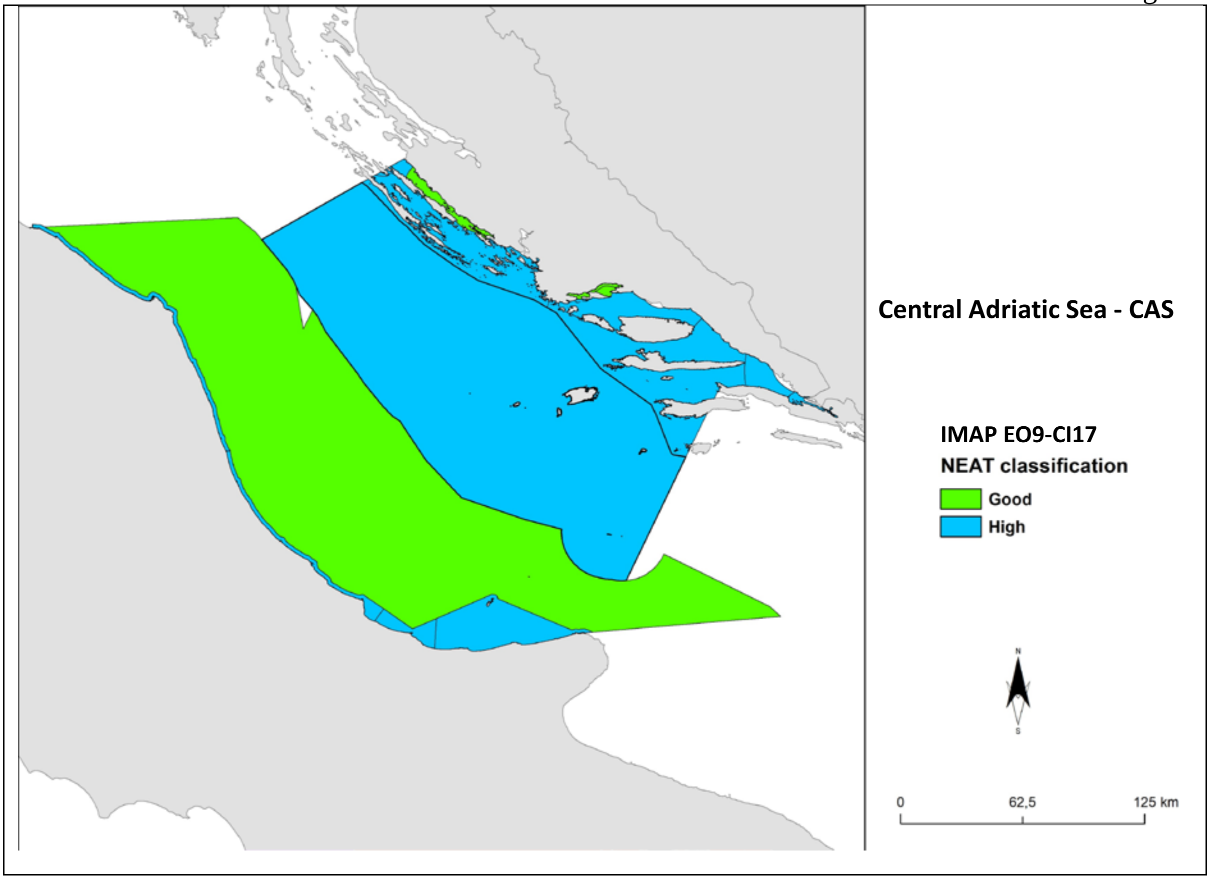


Figure 7: The NEAT assessment results for IMAP EO9/CI17 in the Central Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status.

45. The overall status of CI17 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.

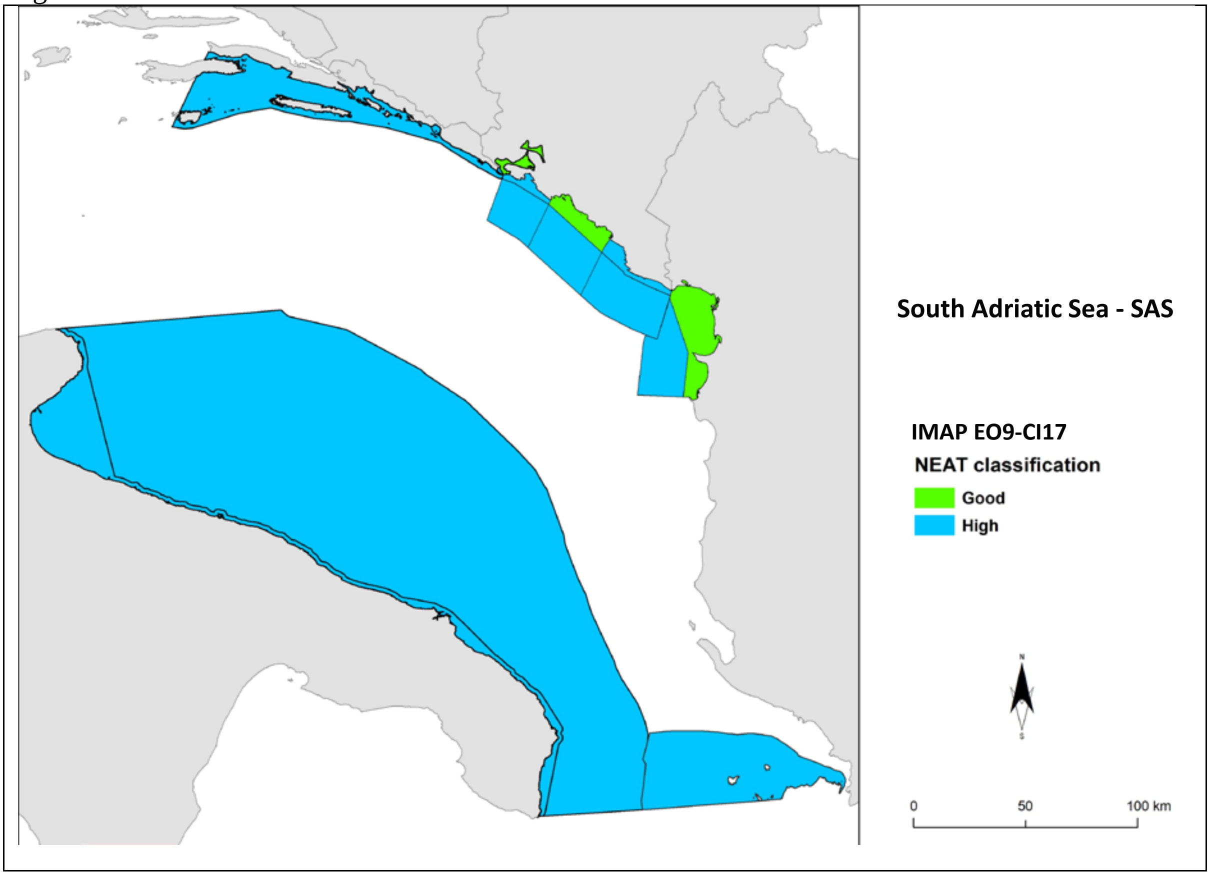


Figure 8: The NEAT assessment results for IMAP CI17 in the South Adriatic Sea. All IMAP SAUs are in GES, characterized by High or Good status. Blank area corresponds to no available data.

46. The overall status of CI17 on the sub-division level for SAS is High and in GES. Four out of 14 SAUs are classified under Good conditions the rest under High.

6.1 Sensitivity analysis of the assessment results

47. The assessment status as obtained by the NEAT tool is the one based on the average value of monitoring data. However, based on the standard deviation per chemical compound and per SAU, the NEAT tool provides a sensitivity analysis for calculating the uncertainty of the assessment results using a Monte-Carlo simulation model for 1000 iterations.

48. In other words, 1000 assessments are run using different random combinations of the data. Instead of using the average value of the parameters inserted by the user, other random values are used by the tool to run the assessment. The selection of these random values is done based on the standard deviation and it is repeated 1000 times with different combinations. The resulting assessment value of each of these 1000 assessment runs is recorded and may lead to a different assessment classification than the one based on the average value. The number of times (out of 1000) of the appearance of these different assessments is given in Table 13, Section 6.1 in UNEP/MED WG.533/Inf.4. For example, the overall status for the SAU AL-SAS-12 is reported as ‘high’. However, from Table 13, Section 6.1 in UNEP/MED WG.533/Inf.5, it is understood that out of 1000 iterations, 409 lead to Good status, and 591 to High Status. These results imply a rather high uncertainty (confidence 59.1%), in contrast to HRO-0313-JVE where 938 iterations led to High status and only 62 to Good (confidence 93.8%).

49. As for any assessment results, the accuracy of the results described above, is dependent on the analytical accuracy of the chemical data i.e. the quality of data reported to IMAP IS and their reproducibility and comparability among all the laboratories as well by the amount of data available for each SAU. It should be stressed here, that the sensitivity analysis described above cannot compensate for the analytical differences among the laboratories or for the lack of data. For instance, in many of the subSAUs data were representative of one monitoring station visited once. Despite to small quantum of data assessed in this case, the value of standard error inserted in the NEAT tool is equal to zero and the propagated error is extremely low, therefore there is high confidence value. In other cases, many subSAUs totally lack of data (blank cells in Tables 3, 4 and Annex III), therefore the integrated results on the upper SAU level actually reflect the status of one or two subSAUs and cannot be considered indicative of the overall SAU status with confidence. In conclusion, the interpretation of the NEAT assessment results should always take into consideration the afore mentioned factors, having in mind that NEAT is just a tool which calculates numbers based on input data.

Annex I

Calculation of the SAU weight factors by the NEAT tool

(provided by the NEAT developers: Torsten Berg and Angel Borja)

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.

The overall principle is that the sum of all weights in the nesting scheme (SAU tree) is equal to 1. By adding up the weights of all individual SAUs in a SAU nesting scheme, this sum will always be 1.

The next thing is, a SAU without data will have a total weight of zero, e.g. for the present case there is no contaminants data for the top SAU, the Adriatic Sea. So, its weight will be zero and this will give more weight to the SAU lower in the hierarchy (or to siblings on the same hierarchy level).

<u>i) Weighting based on the nesting hierarchy only - NEAT option *'Do not weight by SAU area'*:</u>

For the case that every SAU has data for at least one chemical parameter, and we do not weight by area (and we use no priority factors). Then the area is treated as if it were 1. There is one top-level SAU (the Adriatic Sea) and below there are the Northern, Central and Southern Adriatic Seas. Hypothetically it is assumed there are also 4 SAUs beneath the Northern Adriatic Sea.

The calculation starts by assigning that the total weight of the SAU tree must be 1. This weight needs to be distributed among all SAUs in the tree. That means, the top SAU cannot have it all, it must share the 1 with its three children (Northern, Central, Southern). In total, this makes 4 SAUs that need to share the total weight of 1. So, the top-level SAU (the Adriatic Sea as a whole) and each of the children (Norther, Central, Southern) get 0.25 of the total tree weight:

w(total) = 1

w(Adriatic) = 0.25
v(Northern) = 0.25
v(Central) = 0.25
v(Southern) = 0.25

Note that we write w = final weight, and v = inherited weight.

For the top-level SAU, the 'w(Adriatic) = 0.25' is its final weight as it has shared the weight of 1 (which was inherited in the first place) among itself and its children. Now, each of the children must do the same. The weight which they now got, is not their final weight (named w above). It is the weight they inherit from their parent SAU (named v above) and that they need to share with their children. Hypothetically it is assumed that the 4 children of the Northern Adriatic Sea are called N1, N2, N3 and N4. The inherited weight of 0.25 needs to be shared among the Northern Adriatic Sea and N1, N2, N3 and N4. This is 5 SAUs. So, 0.25 is divided by 5 and it gets 0.05. That is the final weight of the Northern Adriatic Sea and the weight its children will inherit in the first place:

w(total) = 1 = v(Adriatic)
w(Adriatic) = v(Adriatic)/4 = 0.25

w(Northern) = v(Northern)/5 = 0.05
v(N1) = 0.05
v(N2) = 0.05
v(N3) = 0.05
v(N4) = 0.05

The total weight of 1 is the same as the weight inherited to the whole Adriatic Sea. And the final weight is its inherited weight divided by the number of SAUs involved. The same principle can be applied to all further children in any possible SAU tree. If the tree stopped here, the one could take all w(...) values and add them together. As N1 through N4 have no children (as well as the Central and the Southern Adriatic) their inherited weight is the same as their total weight as they do not need to share it with any children. There are no further children anymore:

w(Adriatic) + w(Northern) + w(Central) + w(Southern) + w(N1) + w(N2) + w(N3) + w(N4)
= 0.25 + 0.05 + 0.25 + 0.25 + 0.05 + 0.05 + 0.05 + 0.05 = 1

The total weight of the tree is 1, as expected.

ii) <u>Weighting based on the nesting hierarchy and the SAU surface area - NEAT option: *'Weight by SAU area'*:</u>

In this case, the area is used instead of 1 but making sure the total weight is still 1. The one used a for the area, for example:

a(Adriatic) = 139783 km^2
a(Northern) = 31856 km^2
a(Central) = 63696 km^2
a(Southern) = 44231 km^2

w(total) = 1 = v(Adriatic)
w(Adriatic) = v(Adriatic)*a(Adriatic)/[a(Adriatic) + a(Northern) + a(Central) + a(Southern)]
= 1 * 139783 / (139783 + 31856 + 63696 + 44231)
= 1 * 139783 / 297566
= 0.4698

Here, instead of adding the number of SAUs (the one at the top-level plus all its children), their areas are just added. The value of 0.4698 will now be the inherited weight for the Northern, Central and Southern Adriatic sub-divisions and is placed in the formula instead of the 1 above. So, v(Northern) will be 0.4698 and this weight is distributed among itself and N1 through N4. Again, the one add the areas of all those 5 SAUs, divide the area of the Northern Adriatic Sea by this sum and multiply with the inherited weight of 0.4698 and this will give the final weight of the Northern Adriatic Sea (and of its children if they do not have any children themselves).

The above apply under the assumption that there are data inserted to each of the nested SAUs. In the present analysis for the IMAP CI17 this is not the case and the weight calculation becomes more complex.

Annex II

The spatial assessment units (SAUs) for the Adriatic Sea Sub-region along with the spatial and temporal coverage of monitoring data collected for the Adriatic Sea

Table 1. 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**	**68**	**0.002**
	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-1		2592	19	0.007
			Emilia Romagna	371	6	0.016
			Friuli Venezia Giulia	575	4	0.007
			Veneto	1646	9	0.005
		MAD_SI_MRU_11		55	6	0.110
	NAS offshore			**22788**		
		IT-NAS-12		10540	23	0.002
		MAD_SI_MRU_12		129	2	0.016
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

Sub-division	IMAP Assessment Zone	IMAP SAU	IMAP sub SAU	Area (km^2)	Total No stations	stations / area
			HRO-O423-MOP	2480	1	0.000
		IT-CAS-1		2092	20	0.010
			Abruzzo	282	8	
			Marche	319	8	
			Molise	229	2	
	CAS offshore			**54303**		
		IT-CAS-12		22393	25	0.001
		MAD-HR-MRU_4		18963	1	0.000
South Adriatic (SAS)				**44231**	**58**	**0.001**
	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-1	(Apulia)	1810	8	0.004
		MNE-1		483	11	0.023
			MNE-1-N	86	3	
			MNE-1-C	246	6	
			MNE-1-S	151	5	
			MNE-Kotor	85	13	0.153
		AL-1		646	4	0.006
	SAS offshore			**36955**		
		IT-SAS-12		22715	5	0.000
		MNE-12		2076	12	0.006
			MNE-12-N	513	3	
			MNE-12-C	713	4	
			MNE-12-S	849	6	
		AL-12		716	2	0.003
		MAD-EL-MS-AD		2253	1	0.0004

Table 2: 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)				**68**	**43**	**23**	**21**	**4**	**11**
	NAS coastal/intercoastal								
		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-1		**19**	**23**	**13**			
			Emilia Romagna	6	16	6			
			Friuli Venezia Giulia	4					
			Veneto	9	7	7			
		MAD_SI_MRU_11		**6**	**8**		**8**	**4**	
	NAS offshore								
		IT-NAS-12		**23**	**12**	**10**	**2***		
		MAD_SI_MRU_12		**2**					
Central Adriatic (CAS)				**58**	**23**		**12**		**6**
	CAS coastal/intercoastal								
		MAD-HR-MRU-2		**14**			**6**		**6**

Sub-division	**Zone**	**SAU**	**sub SAU**	**No stations sediment**			**No stations biota**		
				TM	**PAHs**	**PCBs**	**TM**	**PAHs**	**PCBs**
			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-1		**18**	**8**				
			Abruzzo	8	8				
			Marche	8					
			Molise	2					
	CAS offshore								
		IT-CAS-12		25	**7**		**6**		
		MAD-HR-MRU_4		1					
South Adriatic (SAS)				**58**	**33**	**26**	**20**	**12**	**13**
	SAS coastal/intercoastal								
		MAD-HR-MRU_2		**3**			**5**		**2**
			HRO313-ZUC	1			1		1
			HRO423-MOP	2			2		1
		IT-SAS-1	**(Apulia)**	**8**			**2**		
		MNE-1		**27**	**22**	**15**	**15**	**12**	**11**
			MNE-1-N	3	3	1			
			MNE-1-C	6	6	5	2	2	2
			MNE-1-S	5	5	3	1	1	1
			MNE-Kotor	13	8	6	12	9	8
		AL-1		**4**					
	SAS offshore								
		IT-SAS-12		**5**					
		MNE-12		**12**	**11**	**11**			
			MNE-12-N	3	2	2			
			MNE-12-C	4	4	4			
			MNE-12-S	6	5	5			
		AL-12		**2**					
		MAD-EL-MS-AD		**1**	**1**				

Table 3: 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.

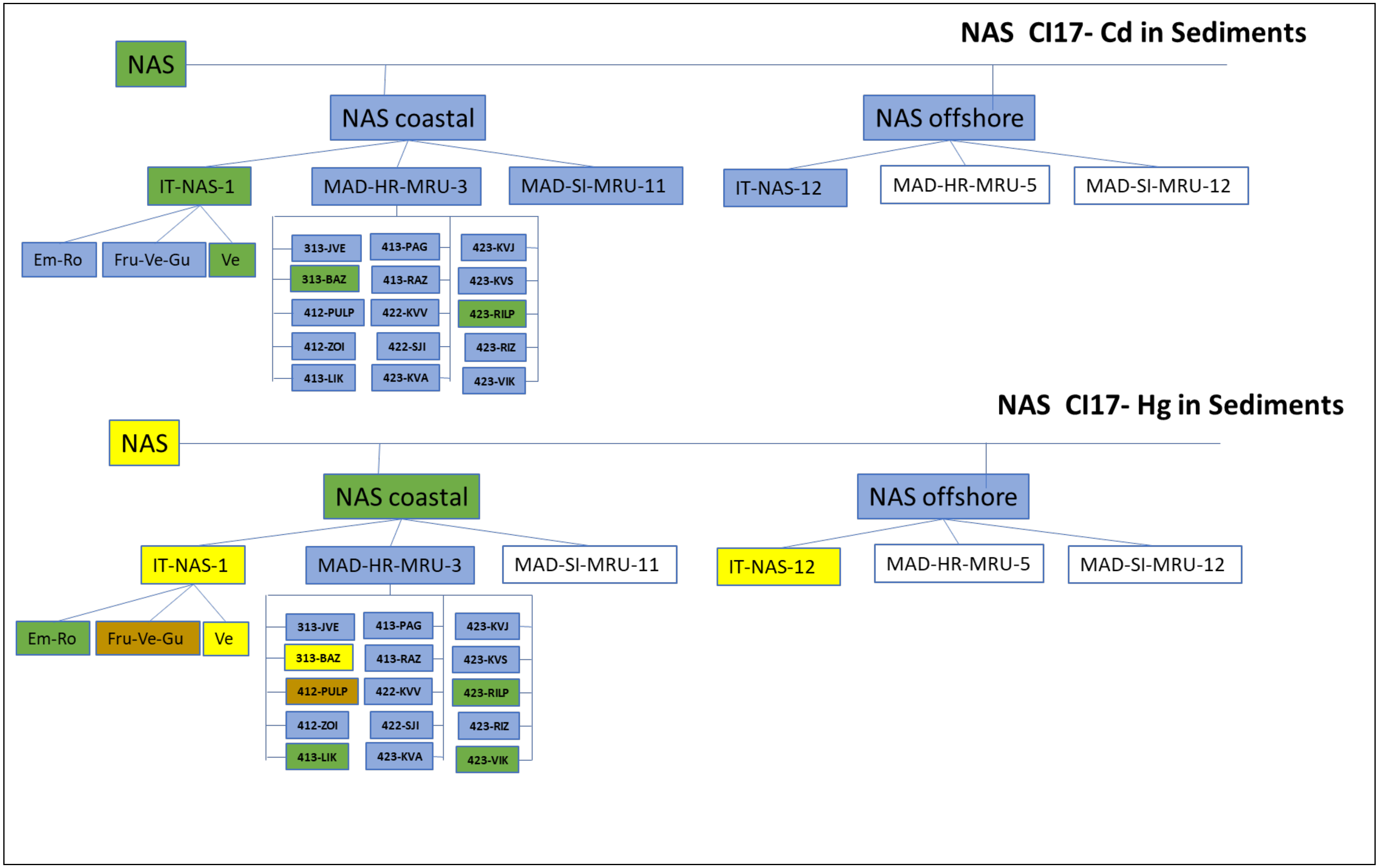
Sub-division	Zone	SAU	Years monitored Sediments			Years monitored biota		
			TM	PAHs	PCBs	TM	PAHs	PCBs
North Adriatic (NAS)								
	NAS coastal/intercoastal							
		MAD-HR-MRU-3	’17, ’19			’19, ’20		‘19
		IT-NAS-1	’15, ’16, ’17, ‘18, ‘19	’16, ’17, ‘18, ‘19	’16, ’17, ‘18, ‘19			
		MAD_SI_ MRU_11	‘19	’13, ’14, ‘15, 16			’16, ‘20	
	NAS offshore							
		IT-NAS-12	’16,’17, 18, ‘19	’16, ’17, ‘18,	’16, ’17, ‘18,	’15, ’16, ‘17		
		MAD_SI_ MRU_12				’17, ’18, ’19, ‘20		
Central Adriatic (CAS)								
	CAS coastal/intercoastal							
		MAD-HR-MRU-2	’17, ‘19			’19, ’20		‘19
		IT-CAS-1	’15, ’16, ’17, ‘18, ‘19	’16, ’17, ‘18				
	CAS offshore							
		IT-CAS-12	’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-1	’15, ’16, ’17, ‘18, ‘19			’15, ’16, ’17, ‘18,		
		MNE-1	’16, ’17, ’19, ‘20	’18, ’19, ‘20	’19, ‘20	’19, ‘20	’19, ‘20	’19, ‘20
		AL-1	‘20					
	SAS offshore							
		IT-SAS-12	’16, ‘17					
		MNE-12	‘19	’18, ’19, ‘20	’19, ‘20	‘18, ’19, ‘20		’19, ‘20
		AL-12	‘20					
		MAD-EL-MS-AD	‘18	‘18				

Annex III

Schematic representation of the NEAT assessment results in the nesting scheme of the Adriatic Sea Sub-region according to the NEAT color scale

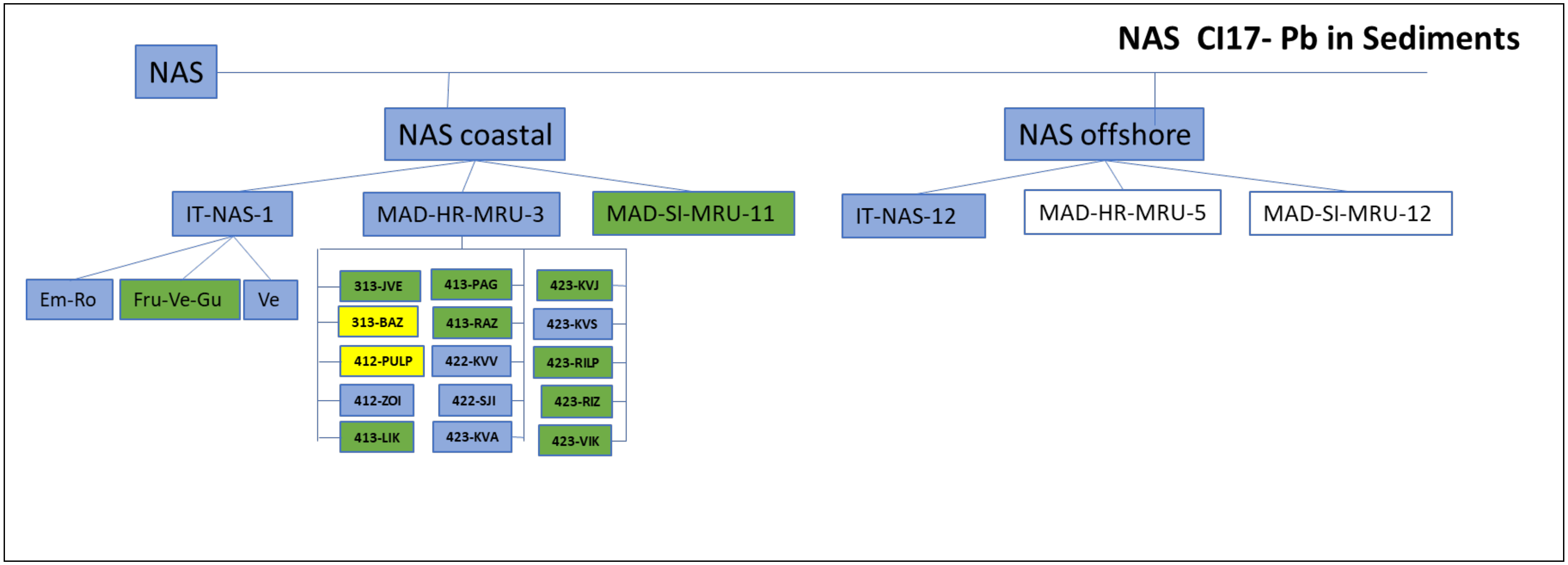
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the North Adriatic Sea (NAS) sub-division per contaminant in sediments (Cd & Hg).

Blank boxes denote absence of data



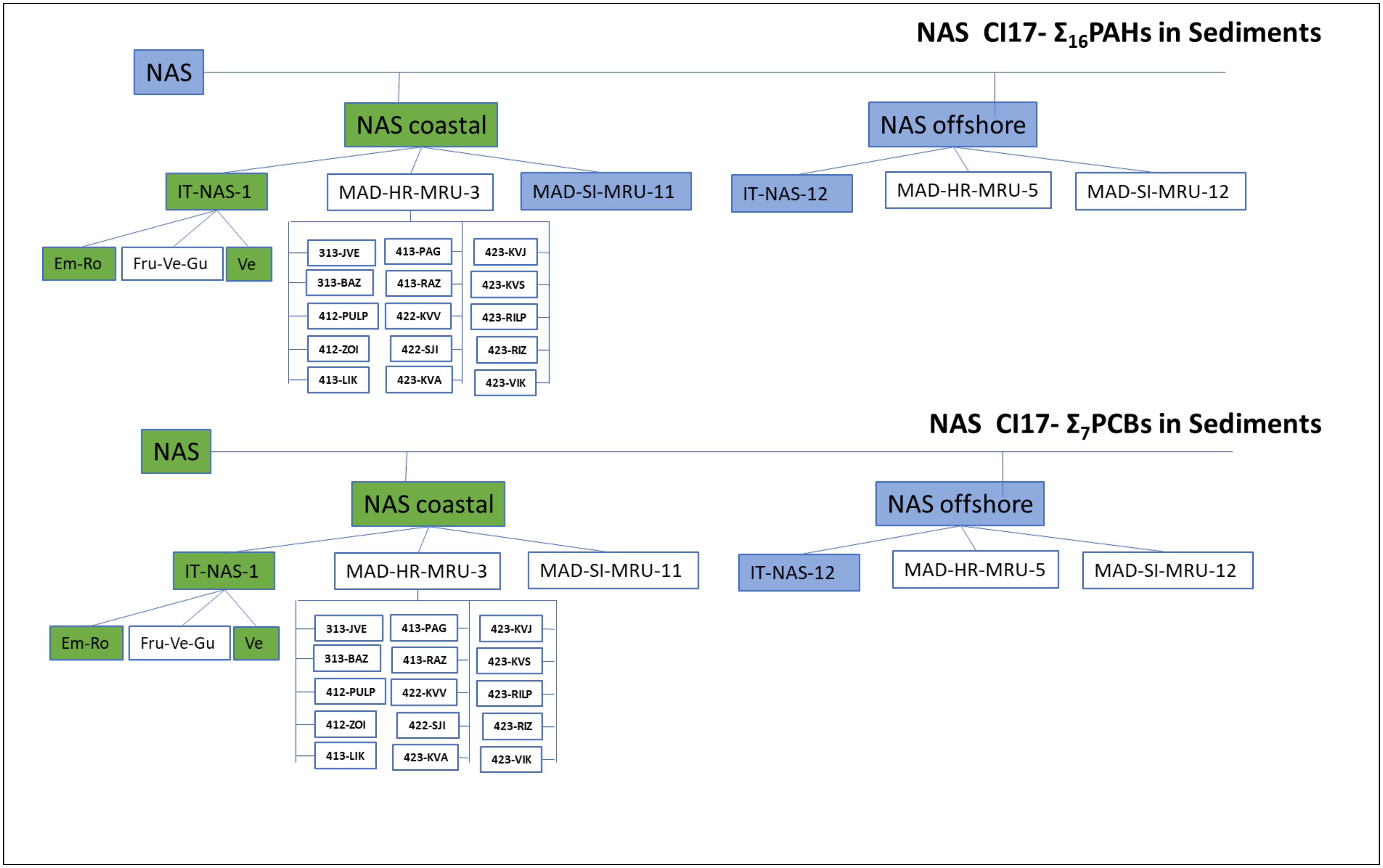
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the North Adriatic Sea (NAS) sub-division per contaminant in sediments (Pb)

Blank boxes denote absence of data



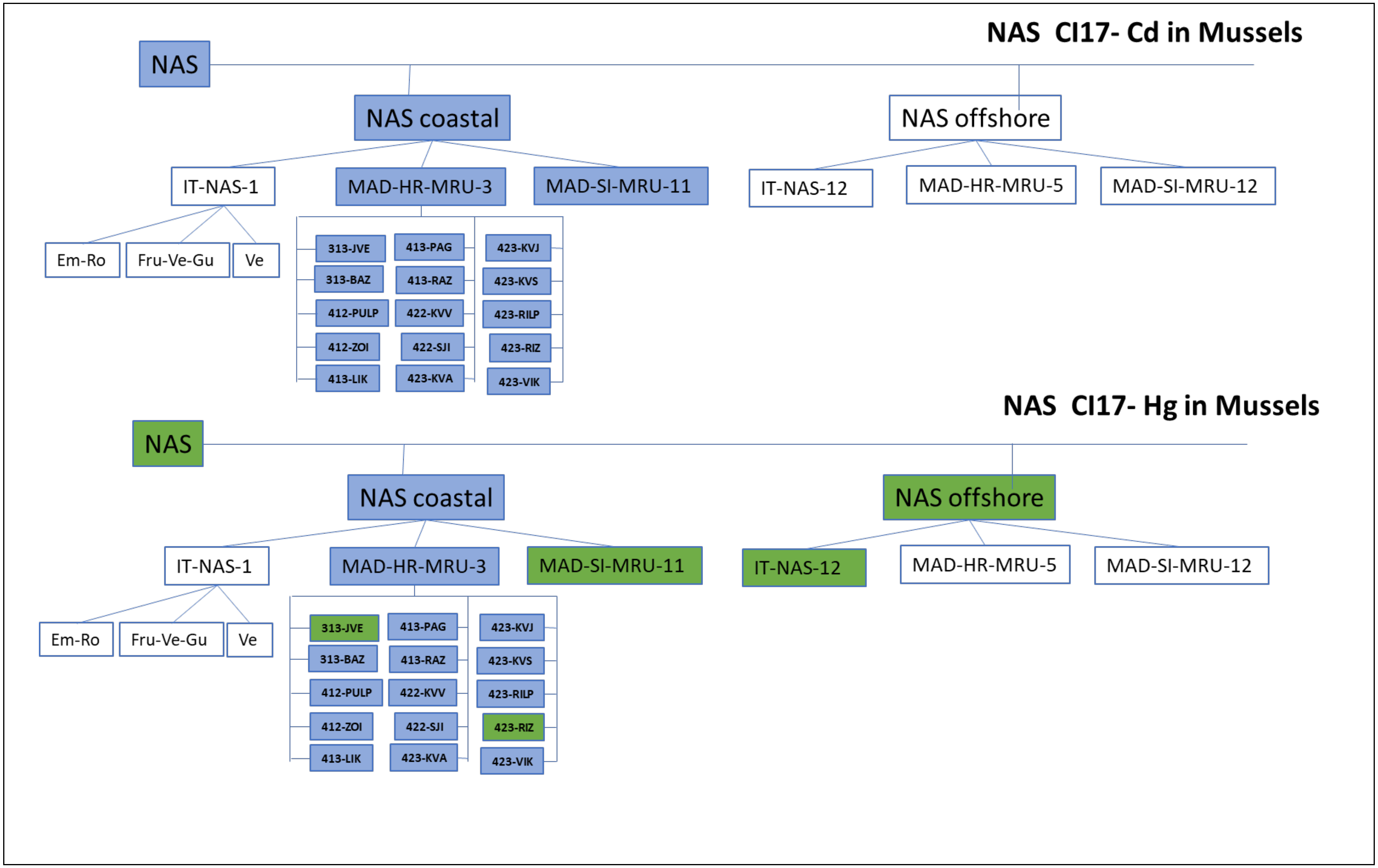
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the North Adriatic Sea (NAS) sub-division per contaminant in sediments (Σ_{16}PAHs & Σ_7PCBs)

Blank boxes denote absence of data



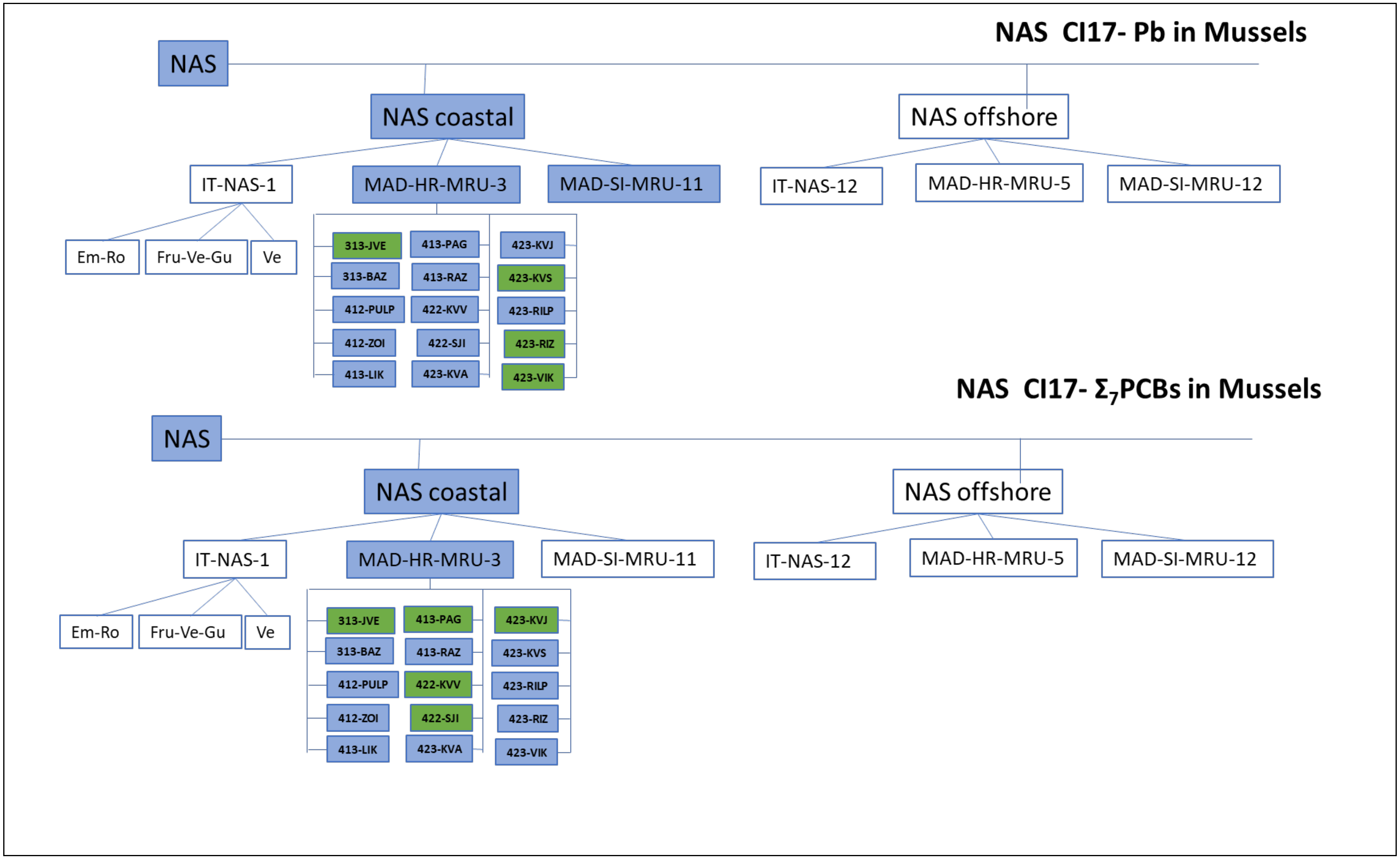
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the North Adriatic Sea (NAS) sub-division per contaminant in mussels (Cd & Hg)

Blank boxes denote absence of data



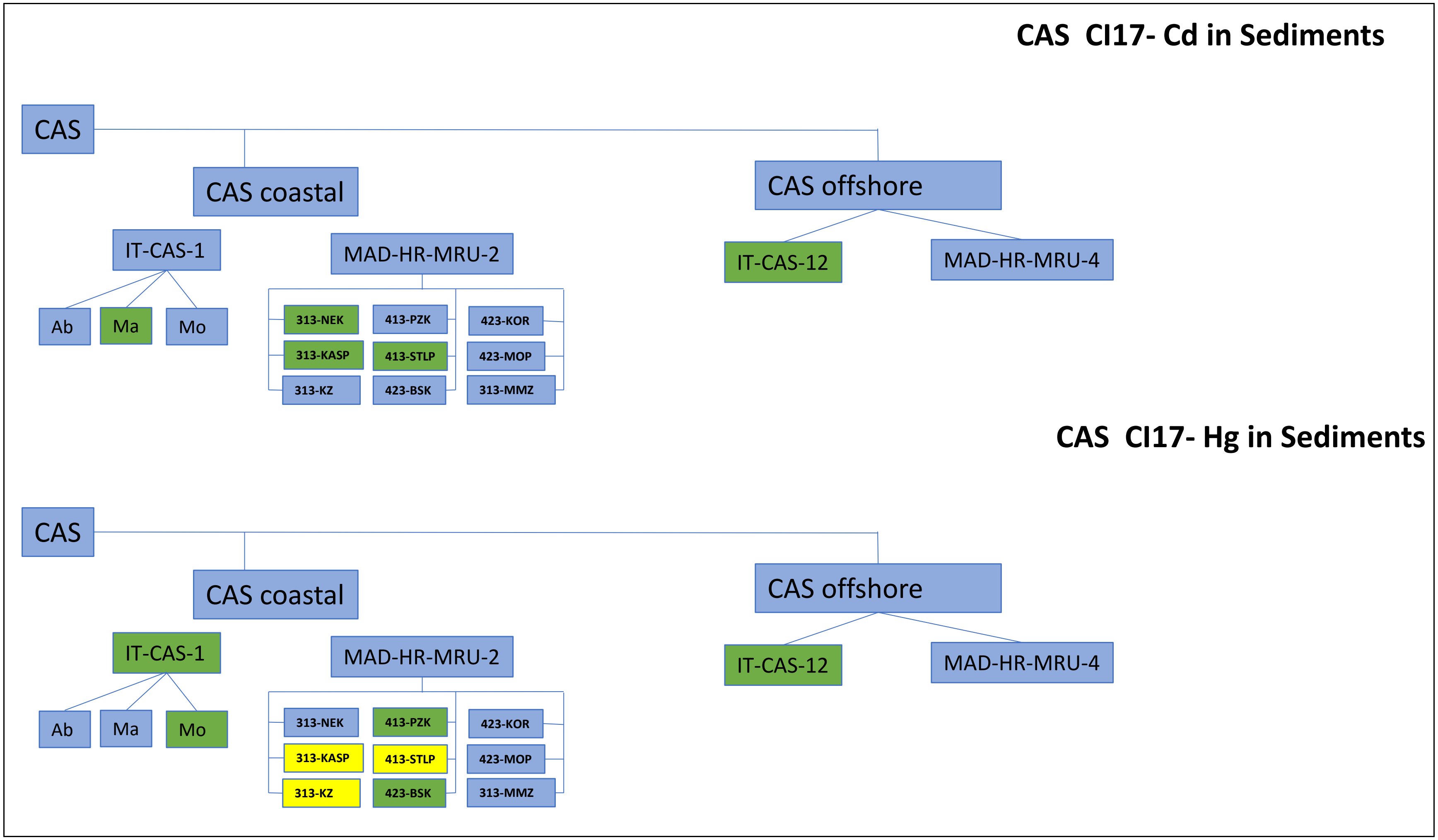
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the North Adriatic Sea (NAS) sub-division per contaminant in mussels (Pb & Σ_7PCBs)

Blank boxes denote absence of data



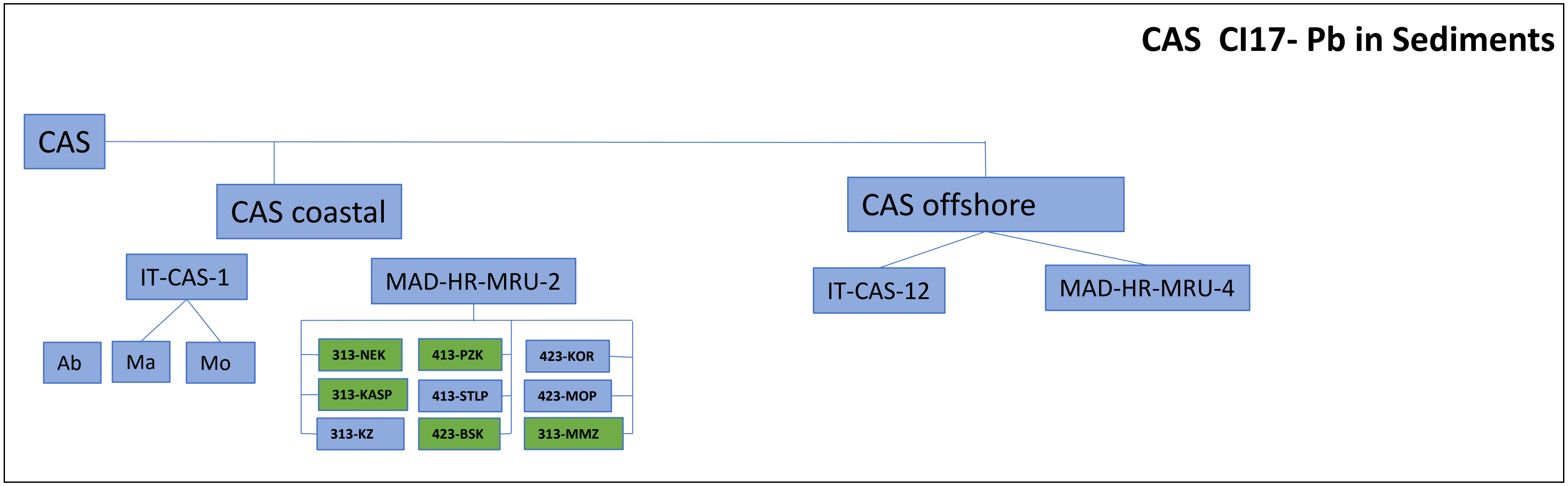
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the Central Adriatic Sea (CAS) sub -division per contaminant in sediments (Cd & Hg)

Blank boxes denote absence of data



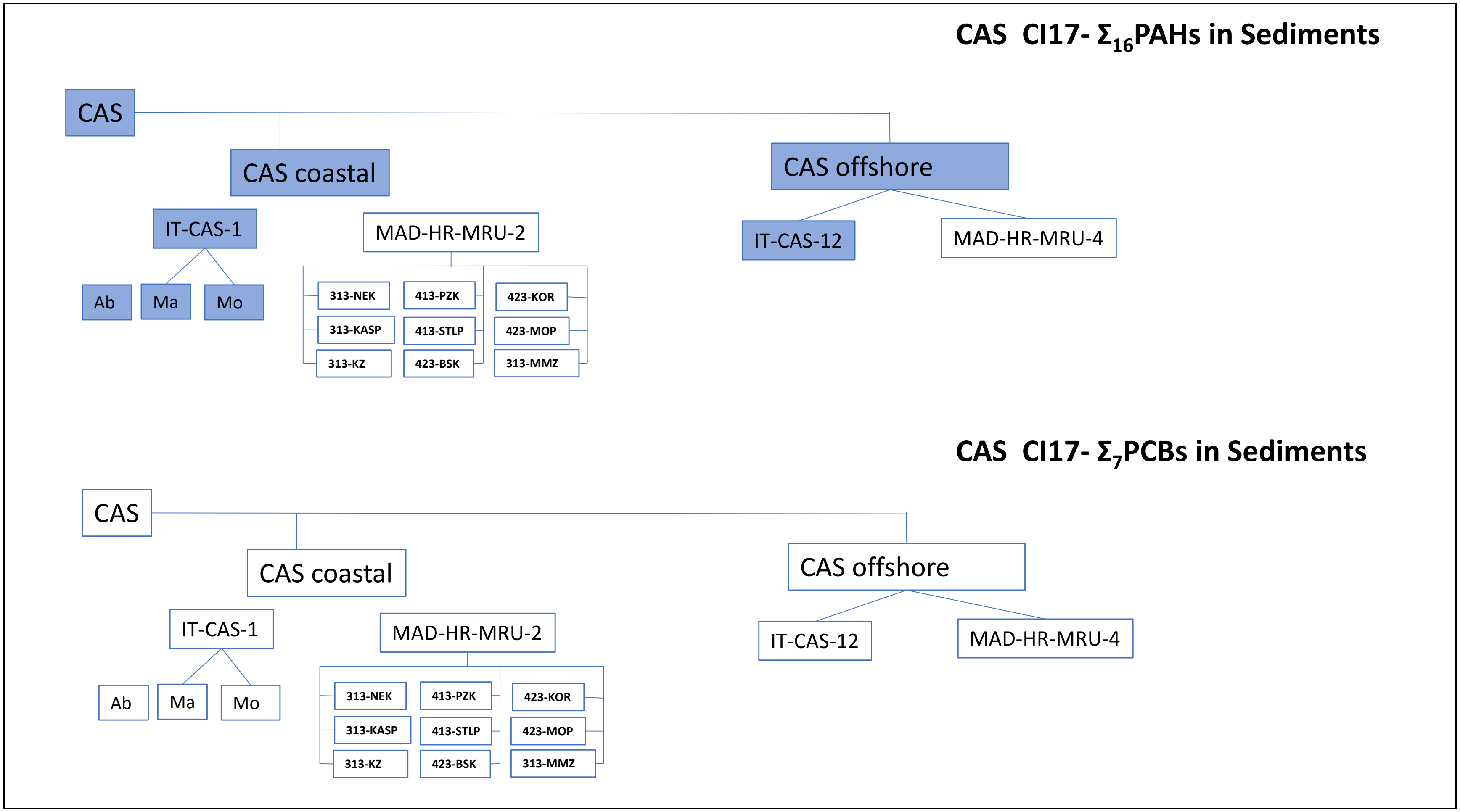
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the Central Adriatic Sea (CAS) sub -division per contaminant in sediments (Pb)

Blank boxes denote absence of data



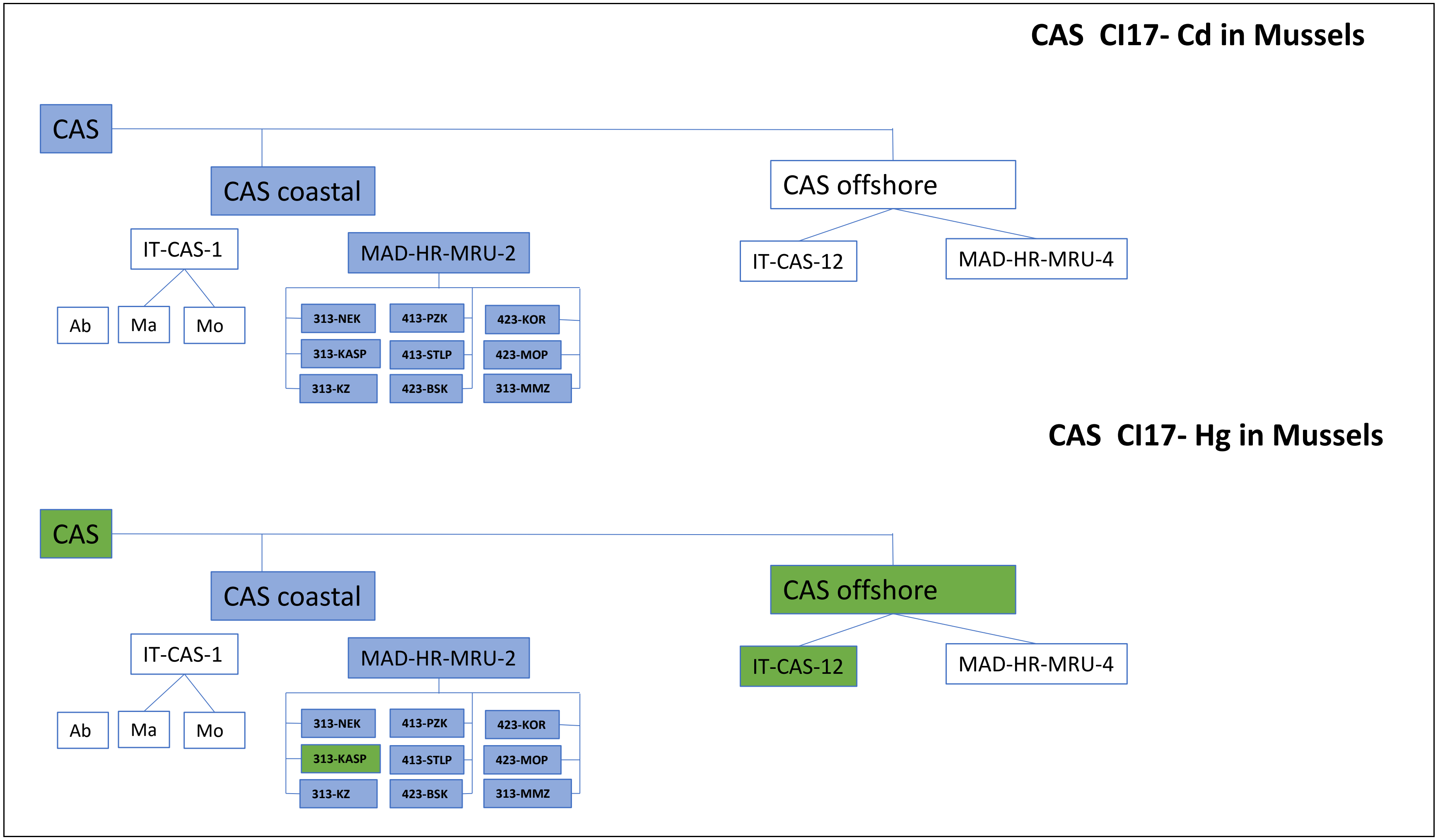
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the Central Adriatic Sea (CAS) sub -division per contaminant in sediments (Σ_{16}PAHs & Σ_7PCBs)

Blank boxes denote absence of data



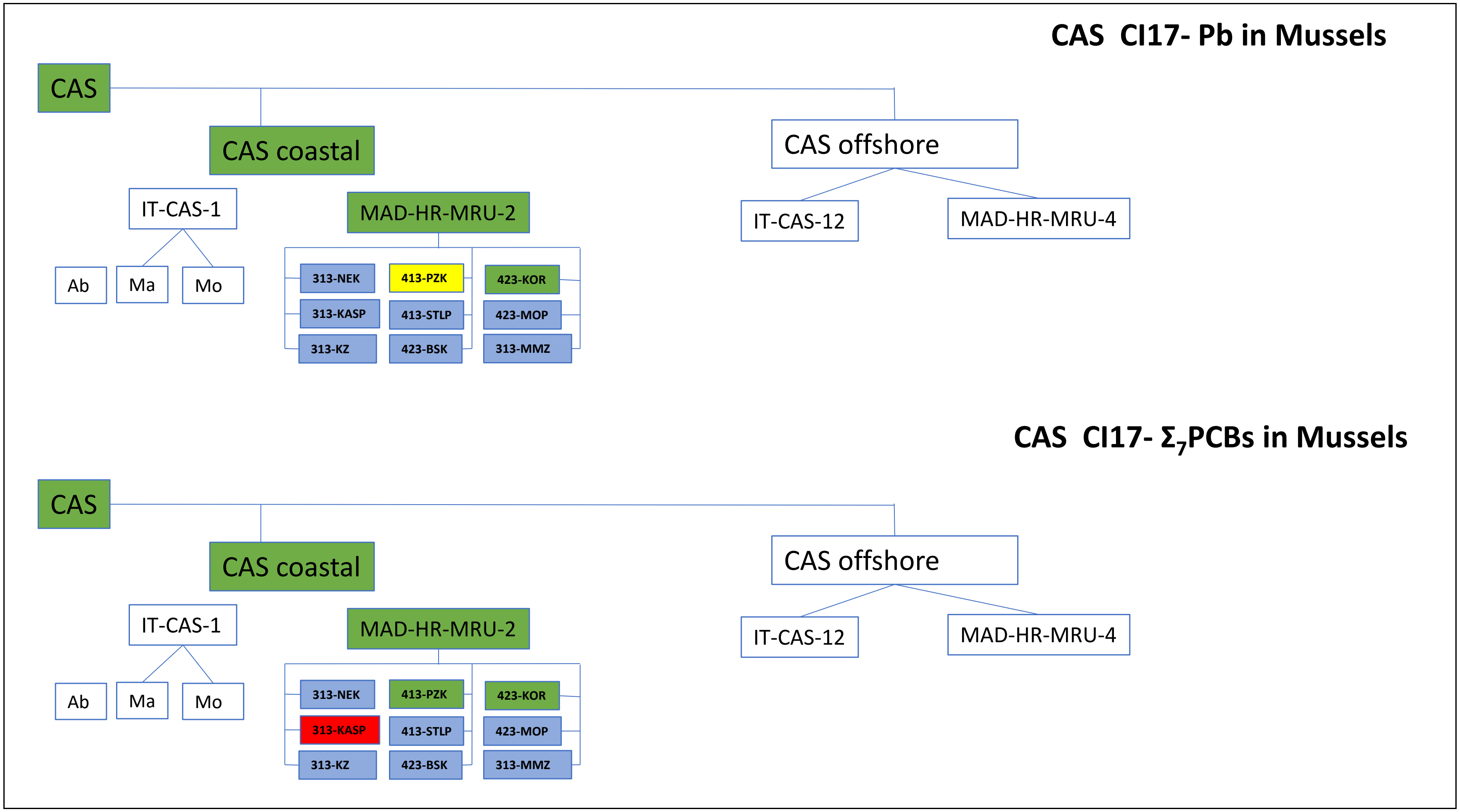
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the Central Adriatic Sea (CAS) sub -division per contaminant in mussels (Cd & Hg)

Blank boxes denote absence of data



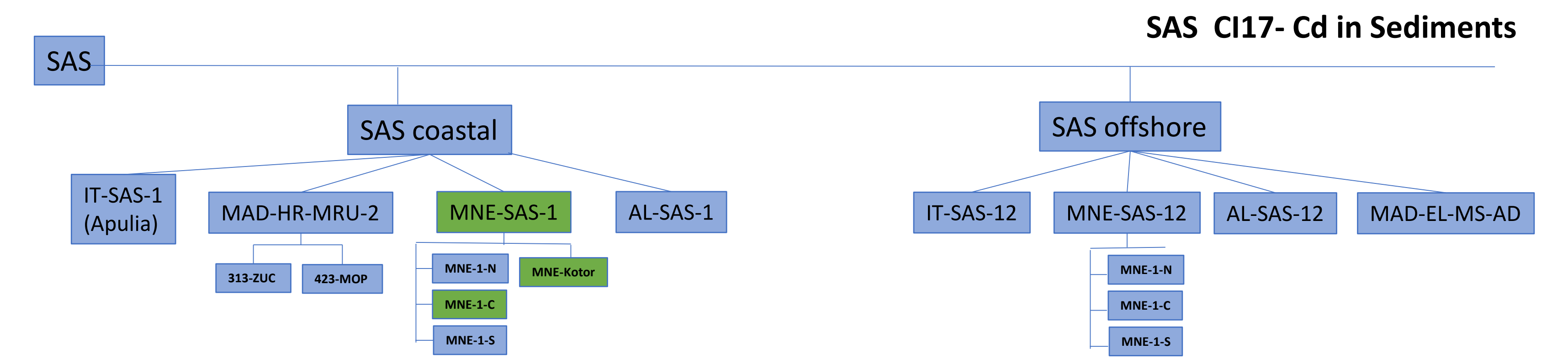
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the Central Adriatic Sea (CAS) sub -division per contaminant in mussels (Pb & Σ_7PCBs)

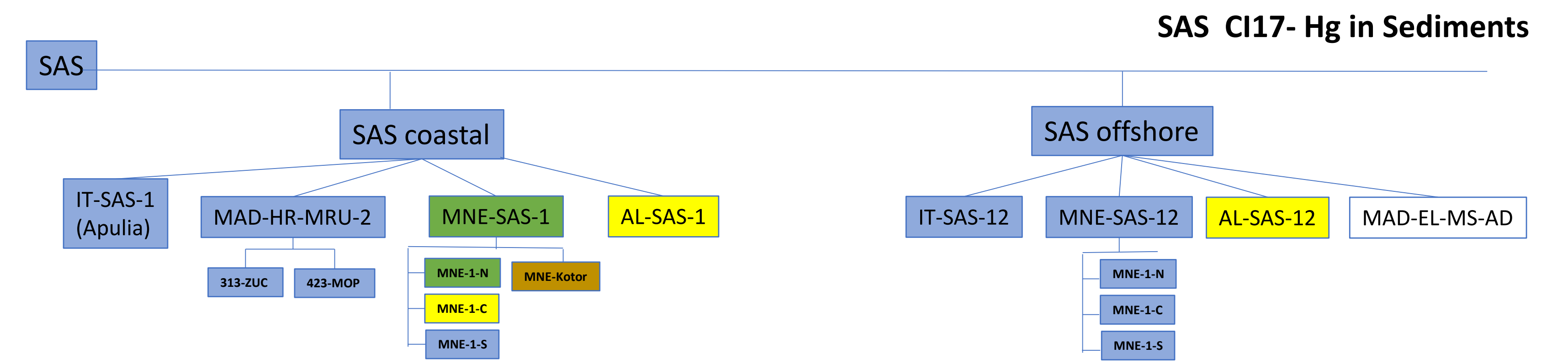
Blank boxes denote absence of data



Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the South Adriatic Sea (SAS) sub -division per contaminant in sediments (Cd & Hg)

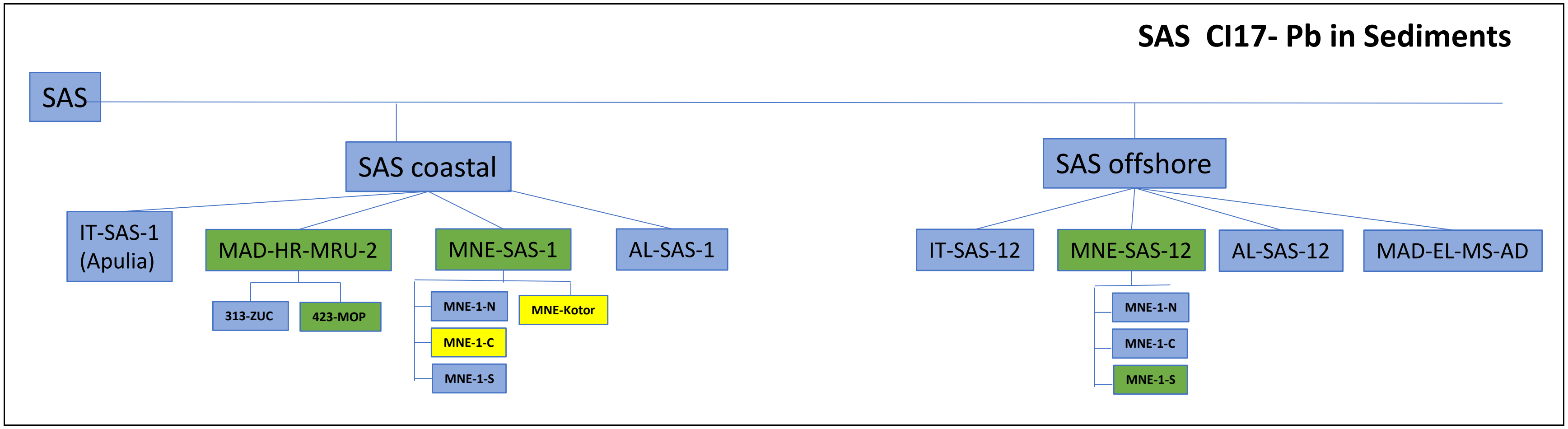
Blank boxes denote absence of data





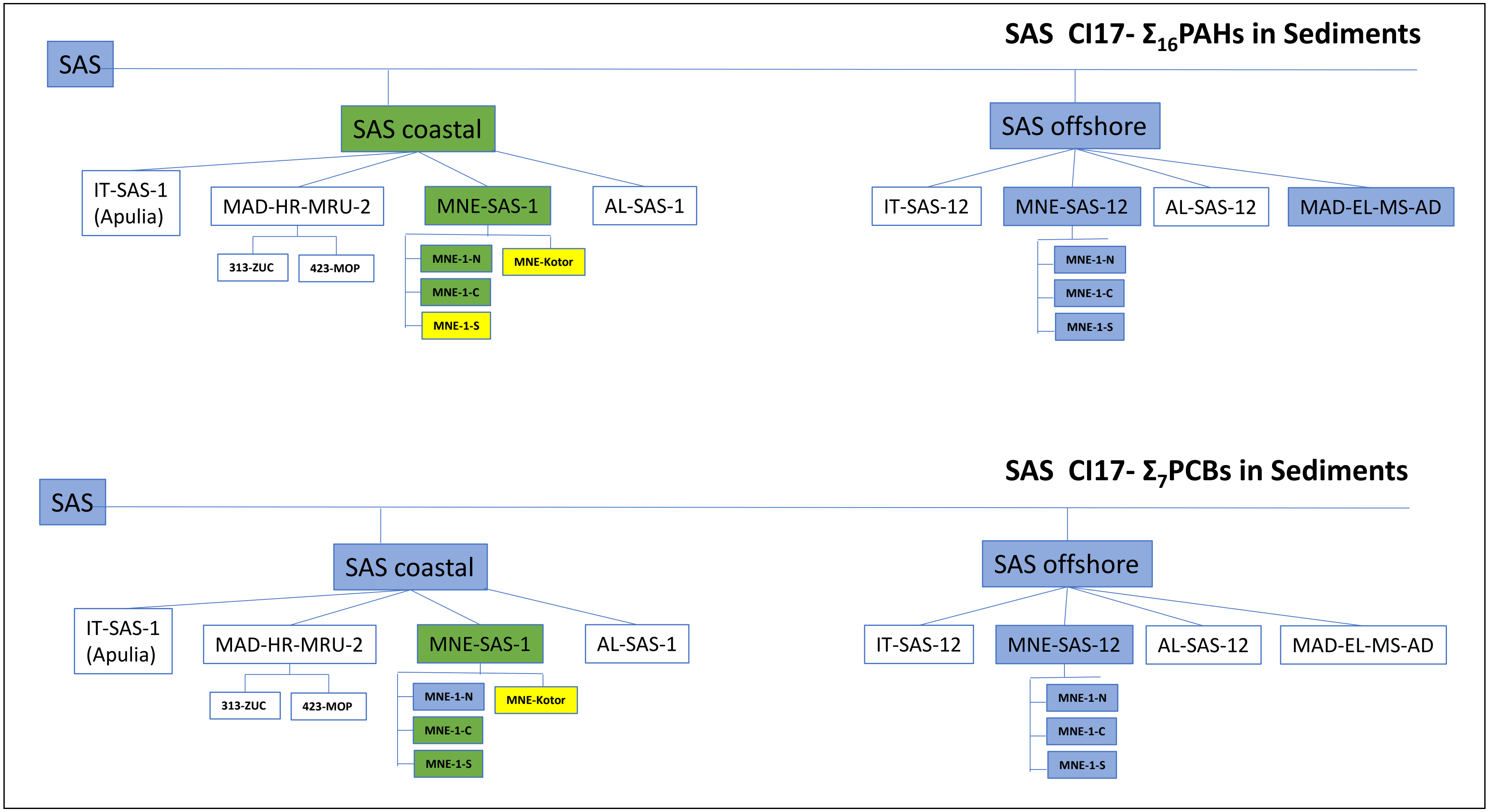
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the South Adriatic Sea (SAS) sub -division per contaminant in sediments (Pb)

Blank boxes denote absence of data



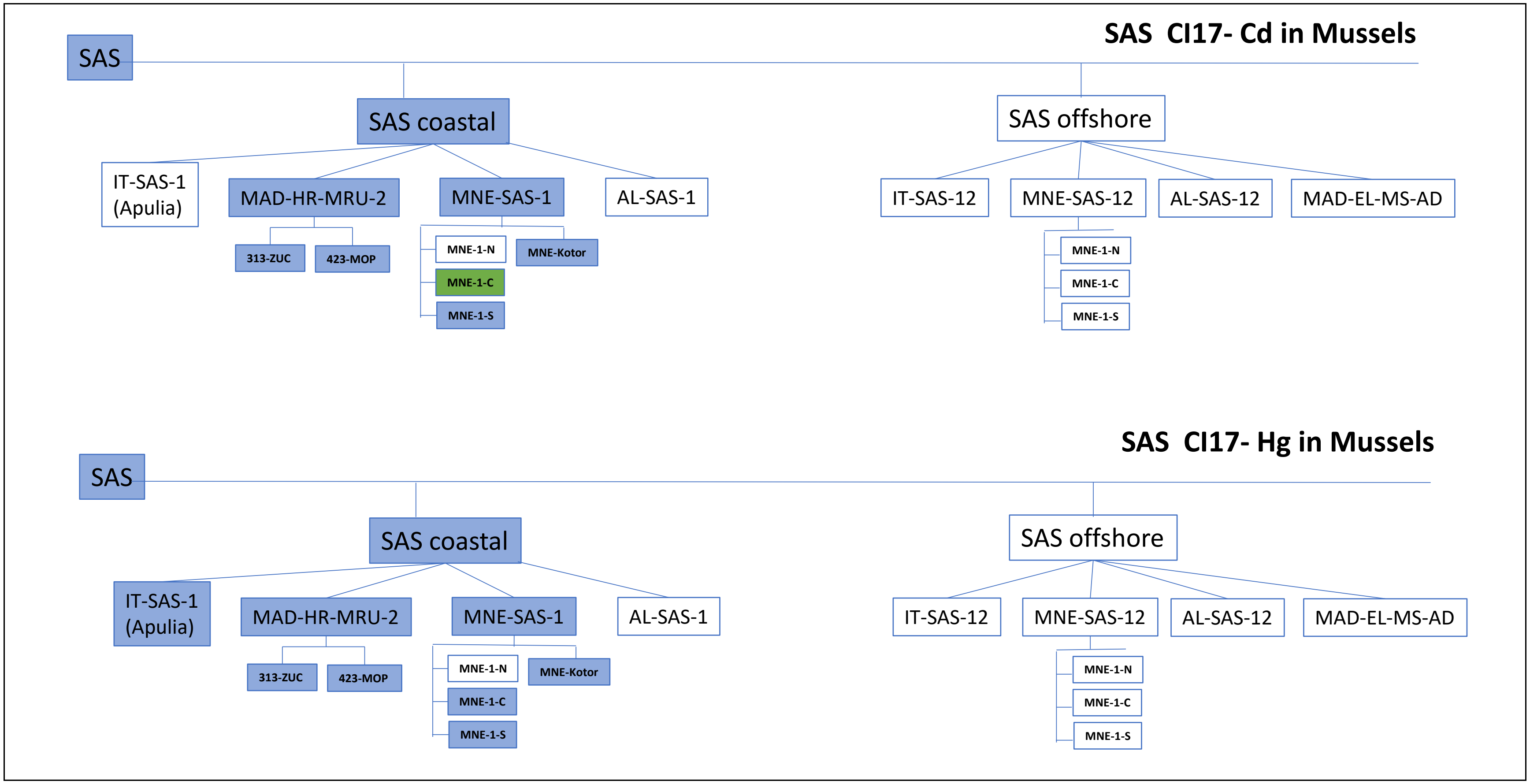
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the South Adriatic Sea (SAS) sub -division per contaminant in sediments (Σ_{16}PAHs & Σ_7PCBs)

Blank boxes denote absence of data



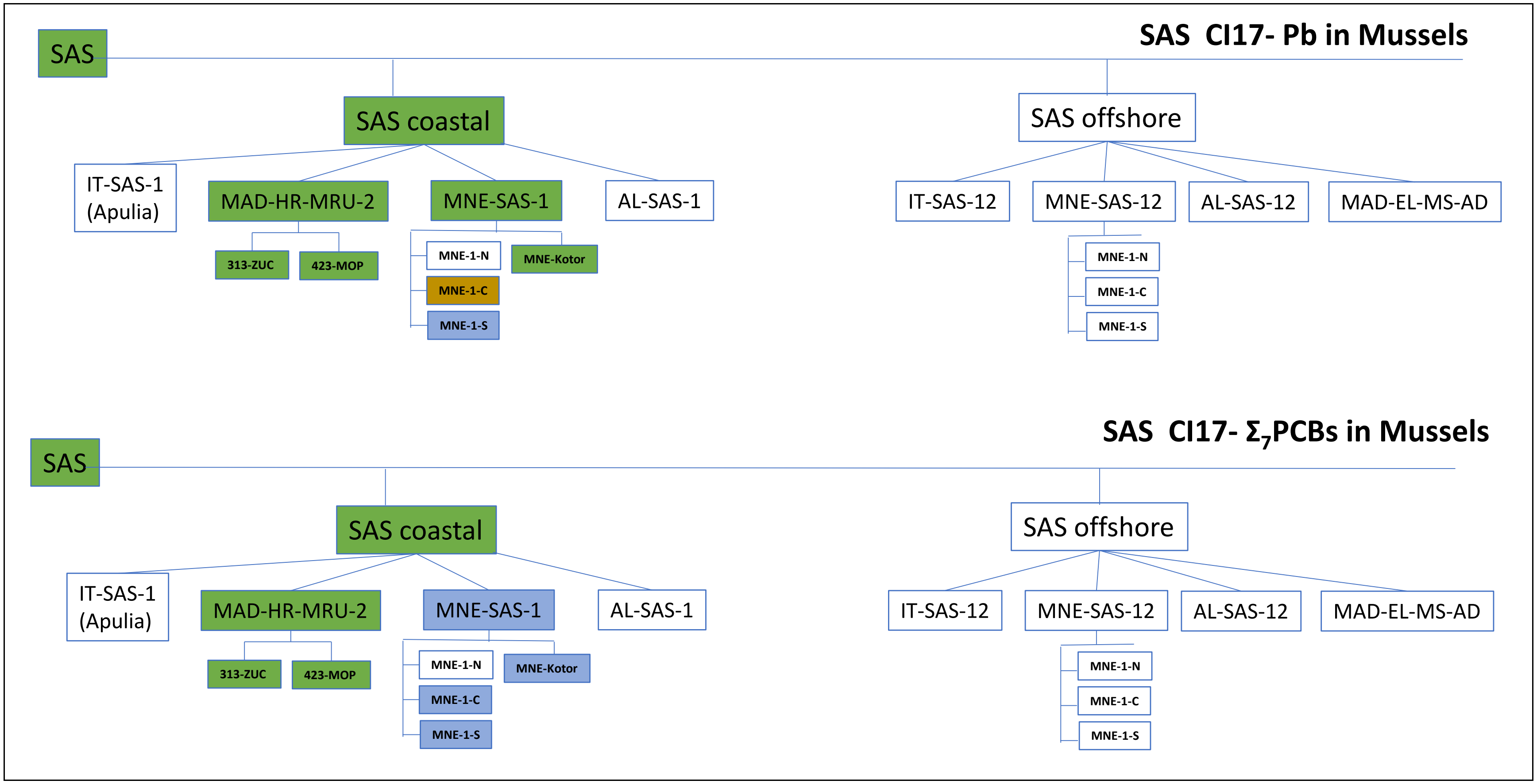
Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the South Adriatic Sea (SAS) sub -division per contaminant in mussels (Cd & Hg)

Blank boxes denote absence of data



Schematic presentation of the assessment results as presented in Table 11 for EO9/CI17 in the South Adriatic Sea (SAS) sub -division per contaminant in mussels (Pb & Σ7PCBs)

Blank boxes denote absence of data



Annex IV

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Appendix 4

The pilot example for Marine Environment Assessment in the Areas with Insufficient Data: The Results of GES Assessment for IMAP Common Indicator 17 in the Levantine Sea Basin (

1. GES assessment of the Levantine Sea Basin – CI 17 (Contaminants), applying the Traffic light and the CHASE+ methodologies: Introduction

1. Updated BC and BAC values for IMAP Common Indicator 17 (CI 17) were calculated and proposed, as presented in documents UNEP/MAP WG. 533/3 and UNEP/MAP WG.533/Inf.3. 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. In addition, following the OWG on Contaminants recommendation, data since 2015 were used in the calculation as well, even if used in the previous assessment.

2. This document presents a pilot application of the above mentioned proposed updated assessment criteria for the Levantine basin of the Eastern Mediterranean sub-division using two different methodologies: the traffic light system and CHASE+ (Chemical Status Assessment Tool) (See explanation below). A separate document presents the application of the proposed updated assessment criteria for the Adriatic sub-region using the NEAT methodology (UNEP/MED WG. 533/5; UNEP/MED WG. 533/Inf.4; UNEP/MED WG. 533/Inf.5).

3. The areas for the pilot applications were chosen based on data availability to perform a more comprehensive assessment, in preparation for the 2023 Mediterranean Quality Status report (QSR). The most complete data set was for the Adriatic sub-region, even though there were still data and spatial gaps (UNEP/MED WG. 533/Inf.3). Data availability was lower for the Levantine Sea Basin sub-division compared to the Adriatic, but higher compared to other sub-regions or sub-divisions.

2. Available data

4. The available data for the Levantine Sea Basin are presented in Table 1. Data were available for trace metals (TM – Cd, Hg and Pb) in sediments for Cyprus, Israel, Lebanon, Turkey; TM in the fish *M. barbatus* for Israel, Lebanon, Turkey; PAHs in sediments for Israel, Lebanon and Turkey and organochlorinated contaminants in sediments for Lebanon and Turkey.

5. The most data were available for TM in sediments. There were 150 stations in the database, with data on Cd and Pb in 149 stations and for Hg in 150 stations. TM in *M. barbatus* were as follows: 87 data points for Cd and Hg and 39 for Pb. Data for PAHs in sediments were available for 104 stations. However, concentrations for the individual PAHs were reported just for 52 stations. Total 16 PAHs (Σ_{16} PAHs) in sediments were reported for 71 stations while for 33 stations the data available were for Σ_4 PAHs and Σ_5 PAHs[1]. Few data were reported for PAHs in *M. barbatus*, and no criteria could be calculated for these elements (UNEP/MAP WG. 533/3 and UNEP/MAP WG. 533/Inf.3). Data for organochlorinated contaminants in sediments were available for 52 stations. However, concentrations for the individual PCBs were reported just for 33 stations. Total PCBs (Σ_7 PCBs) were available for all the stations. Data for Lindane and Dieldrin were available for only 33 stations. Data for Σ_7 PCBs in *M. barbatus* were available for 3 samples. No criteria could be calculated for this element.

6. Based on the available data, the assessment methodologies were applied to TM in sediments and *M. barbatus*, Σ_{16} PAHs in sediments and Σ_7 PCBs in sediment. When possible, a qualitative description was provided for the additional parameters or stations.

[1] Σ_4 PAHs is the sum of the concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene while Σ_5 PAHs is the sum of Σ_4 PAHs and Benzo(ghi)perylene. No criteria are given for these parameters and therefore they were not used in the assessment.

Table 1. Data available for pilot application of proposed updated criteria for the environmental assessment of the Levantine Sea Basin.

Source	**IMAP_File**	**Country**	**Year**	**Cd**	**Hg**	**Pb**	**Σ_{16} PAHs**	**Σ_4 PAHs**	**Σ_5 PAHs**	**Σ_7 PCBs**	**Lindane**	**Dieldrin**
Sediment												
IMAP_IS	125	Cyprus	2013	2	2	2						
IMAP_IS	125	Cyprus	2014	4	4	4						
IMAP_IS	125	Cyprus	2015	3	3	3						
IMAP_IS	125	Cyprus	2016	2	2	2						
IMAP_IS	125	Cyprus	2017	7	7	7						
IMAP_IS	125	Cyprus	2018	4	4	4						
IMAP_IS	#	Israel	2020	14	14	14						
IMAP_IS	410	Israel	2019	16	16	16						
MEDPOL		Israel	2015	20	20	19						
MEDPOL		Israel	2017	14	14	14						
Lit1		Israel	2013				52*					
IMAP_IS	118	Lebanon	2019	17	17	17	19			19		
Lit2		Lebanon	2017	2	3	3						
IMAP_IS	445	Turkey	2018	33	33	33		33	33	33*	33	33
MEDPOL		Turkey	2015	11	11	11						
M. barbatus												
IMAP_IS	351	Israel	2015	28	28	0						
IMAP_IS	71	Israel	2018	13	13	0						
IMAP_IS	410	Israel	2019	7	7	0						
IMAP_IS	152	Lebanon	2019	14	14	14			6	3		
IMAP_IS	323	Turkey	2015	25	25	25	25^					

Data reported to MEDPOL, to be added to IMAP_IS, [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.

3. Location of sampling stations

7. The locations of the sampling stations are presented in Figures in Annex III, sorted by matrix and group of contaminants. TM, PAH and Organochlorinated contaminants in sediments for Lebanon and Turkey 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* were located in the areas close to the sediment samples, but did not encompass one specific station, only a fishing area.

8. Further to IMAP[2] implementation, the monitoring stations were considered for grouping in the two main assessment zones i.e., the coastal and offshore zones. This spatial division and nesting of the spatial assessment units were applied in the NEAT assessment for the Adriatic sub-region (UNEP/MED WG. 533/5; UNEP/MED WG. 533/Inf.4; UNEP/MED WG. 533/Inf.5). Based on that approach setting the two main assessment zones i.e. the coastal 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, 1 station can be considered offshore station. In Turkey, 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 Turkey 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 and Lebanon. In Turkey all stations can be considered coastal, with exception of one station that can be grouped as offshore station.

9. 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 Levantine Sea Basin. Spatial nesting would decrease the reliability and the representativeness of each station for the assessment of the Levantine Sea Basin. Therefore, at this stage of IMAP implementation in the Levantine Sea Basin, the assessment was based on specific stations irrespective of their positions either in offshore or coastal zones.

4. Methodologies

10. Two methodologies were applied in this pilot environmental assessment of the Levantine Sea Basin: the IMAP "traffic light" system and the CHASE+ Chemical Status assessment tool. Both used the proposed updated criteria presented in document (UNEP/MED WG.533/3; UNEP/MED WG.533/Inf.3)

4.1 "Traffic Light" system

11. UNEP/MAP has adopted the threshold assessment methodology, based on the "traffic light" approach, by defining 2 values to classify 3 environmental categories: 1) good; 2) above background but with low risk for environment and biota population, or below dietary limits for fish and sea food concerning human health; and 3) unacceptable. The two thresholds used for this classification are i) the Background Assessment Concentration (BAC) and ii) the Environmental Assessment Criteria (EAC) for TM and organic contaminants in sediments and biota, or EC for TM and organic contaminants in biota. In the traffic light system, each contaminant is characterized as green (below BAC value), red (above EAC value) or yellow (between BAC and EAC values). All the green and yellow statuses of the contaminants are classified as in GES while all the red statuses of the contaminants are classified as non-GES.

4.2 CHASE+ (Chemical Status Assessment Tool)

12. The CHASE+ (Chemical Status Assessment Tool) methodology was used by the European Environmental Agency (EEA) to assess environmental status categories for the European Seas (Andersen et al. 2016, Anon 2019). This assessment methodology uses just one threshold, compared to the two used in the traffic light system.

[2] In the EEA assessment using CHASE+ (Anon, 2019), the assessment areas were defined as a 20x20 km^2 grid for coastal areas and by 100x100 km^2 for offshore areas.

13. The first step in this tool is to calculate the ratio $C_{measured}/C_{threshold}$ called the contamination ratio (CR) for each assessment element in a matrix. Then a contamination score (CS) is calculated as follows[3]:

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

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

14. 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.

15. Both methodologies 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. Here we recommend that if at least 75% of the elements are in GES, the station should be considered in GES. The same recommendation is given when assessing certain areas or the whole Levantine Sea Basin sub-division i.e., when 75% of the stations are in GES for a certain parameter, the whole sub-region is in GES. This more lenient approach for the GES-non GES decision rule compensates for stricter thresholds applied within the CHASE+ methodology (See section 4.3).

4.3 Choice of thresholds for the pilot application for the Levantine Sea Basin

16. The thresholds used for the traffic light system application were the BACs and MED_EACs as provided in the Meeting documents UNEP/MED WG.533/3; UNEP/MED WG.533/Inf.3. The BACs used were the proposed updated regional MED_BACs and for comparison, the proposed updated sub-regional AEL_BACs when available. The assessment presented in the Meeting documents UNEP/MED WG.533/5; UNEP/MED WG.533/Inf.4 was provided for the Adriatic Sea Sub-region, using the updated ADR_BACs as also provided in the Meeting documents UNEP/MED WG.533/3; UNEP/MED WG.533/Inf.3. The thresholds used for the CHASE+ tool were also the updated regional MED_BACs and for comparison, the same analysis was performed using the proposed updated sub-regional AEL_BACs when available. Table 2 summarizes the thresholds values. It is recognized that the choice of threshold will affect the assessment.

[3] 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’.

Table 2. Summary of the threshold values used in present pilot application for GES assessment of the Levantine Sea Basin.

	BAC_MED	BAC_AEL	MedEAC
Sediments, µg/kg dry wt			
Cd	161	118	1200
Hg	75	47.3	150
Pb	22500	23511	46700
Σ_{16} PAHs	32	41	4022*
Σ_7 PCBs	1.2#		68+
***M. barbatus*, µg/kg wet wt**			
Cd	7.8	7.2	50
Hg	81.2	67.4	1000
Pb	36.6	27	300

* ERL value derived for the sum of 16 PAHs by Long et al., 1995, do not appear in the Decisions of COP. # No BACs were proposed. For this pilot application, 3 times the proposed recalculated MED_BC was used, UNEP/MED WG 533/Inf.3 (UNEP/MED WG.492/Inf.11/Rev.2); + sum of the individual MedEACs values of the 7 PCB compounds as they appear in Decision IG.23/6

Comparison of the thresholds used in this piloting of GES assessment for CI-17 in the Levantine Sea Basin to the thresholds used for piloting the GES assessment for CI 17 in the Adriatic Sea Sub-region (UNEP/MED WG.533/5; UNEP/MED WG.533/Inf.4) is presented in Annex I.

5. Results and Discussion

5.1 Traffic light system

17. In this methodology, each measured parameter at each station was classified as green (below BAC value), red (above EAC value) or yellow (between BAC and EAC values). Table 3 summarizes the results, while Annex II presents the tables with the colour coded results for each measured parameter at each station and matrix.

Table 3. Number of data points and their percentage from the total number of data points in each category based on the traffic light system, calculated using the proposed new MED_BACs and adopted MED_EAC. In parenthesis, the number of data points and their percentage classified using the proposed new AEL_BACs and adopted MED_EAC.

		Green (<BAC)		Yellow (<EAC,>BAC)		Red (>EAC)	
	Total number of data points	Number of data points	*Percentage from total data points*	Number of data points	*Percentage from total data points*	Number of data points	*Percentage from total data points*
Sediment							
Cd	149	88 (71)	*59 (48)*	42 (59)	*28 (40)*	19* (19*)[4]	*13* (13*)[4]*
Hg	150	101 (80)	*67 (53)*	18 (39)	*12 (26)*	31 (31)	*21 (21)*
Pb	149	117 (119)	*79 (80)*	27 (25)	*18 (17)*	5 (5)	*3 (3)*
Σ_{16} PAHs	71	55 (47)	*77 (66)*	16 (24)	*23 (34)*	0 (0)	*0 (0)*
Σ_7 PCBs	52	42	*81*	10	*19*	0	*0*
M. barbatus							
Cd	59	58 (58)	*98 (98)*	1 (1)	*2 (2)*	0 (0)	*0 (0)*
Hg	87	76 (69)	*87 (79)*	11 (18)	*13 (21)*	0 (0)	*0 (0)*
Pb	39	39 (36)	*100 (92)*	0 (3)	*0 (8)*	0 (0)	*0 (0)*

*All the points from Cyprus were above EAC, probably due to specific local minerology. They were not taken into account while assessing GES of the Levantine Sea Basin (See footnote 4).

18. Analysis of TM in sediments showed that most of the area are in the “green” status followed by “yellow”, both indicating GES. The use of MED_BACs was more lenient and classified more areas as “green”. The only “red” stations (excluding Cd in Cyprus, as explained in Table 3) were 29 data points for Hg in Israel, 2 data points for Hg in Lebanon, and 5 data points for Pb in Cyprus, with concentrations above the respective MED_EAC. In the case of Hg in Israel, 27 “red” values were assigned to 9 stations located in Haifa Bay, at different sampling years. The area is known to be still contaminated by Hg, even though there was a vast improvement following pollution abatement measures (Herut et al, 1996, 2021). The additional 2 “red” sampling points were located at a sewage sludge marine disposal site in 2015 but not in the same sampling sites in 2017. Cessation of marine disposal caused a drastic improvement of the environmental quality in the area (Kress et al., 2016, 2020). Two “red” Hg points in Lebanon were located off Beirut, stations categorized as hot spots in the IMAP Information System and in Ghosn et al.,

[4] All the points are from Cyprus. 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. 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, they were not considered while assessing the GES of the Levantine basin.

(2020). In the case of Pb in Cyprus, 3 samples originated from Latsi (in different years) and one from Agkirovolio, both stations categorized as hot spots in the IMAP Information System. The additional point was at station Larnaca west. A check of the high Pb concentrations against Al or Fe in the samples, as normalizers, could confirm or refute the traffic light-based classification for these stations.

19. Analysis of Σ_{16} PAHs and Σ_7 PCBs in sediment showed no "red" classification, indicating that all the stations and data points were in GES. Most of the stations were in "green" classification. Qualitatively, all 33 data points for dieldrin were below detection limit and in green status, while all the 33 data points for lindane were lower than 0.14 μg/kg, lower than the proposed BC value of 1.0 μg/kg, and therefore in GES. Dieldrin and lindane were reported only by Turkey.

20. Analysis of TM in *M. barbatus* showed that most samples were classified in the "green" status (from 79% to 100% depending on the metal and threshold). The remaining samples were classified as "yellow". Therefore, all the samples in all areas are in the GES.

5.2 CHASE+ methodology

21. In this methodology, for each measured parameter at each station a contamination ratio (CR) was calculated. For TM in sediments and in *M. barbatus*, a contamination score (CS) was further calculated (see section 4.2), aggregating all 3 metals. For PAHs and PCBs, only one element was available for each class of contaminant (i.e., Σ_{16} PAHs and Σ_7 PCBs, respectively), therefore only CRs were calculated.

22. The CRs and CSs for TMs in sediment and *M.barbatus* were classified in 5 GES-non GES categories as follows: Blue - NPAhigh (CR or CS=0.0-0.5); Green- NPAgood (CR or CS =0.5-1.5); Yellow- PAmoderate (CR or CS =1.5-5.0); Brown - PApoor (CR or CS =5.0-10.0) and Red - PAbad (CR or CS > 10.0). This is slightly different from the classification used by the EEA where NPAgood was defined as (CR or CS =0.5-1.0); and PAmoderate was defined as (CR or CS =1.0-5.0) (Anon, 2019). In the EEA classification, all elements with concentrations below the values used as threshold i.e. boundary limit of 1[5], were considered NPA i.e., in GES.

23. The recommendation to use 1.5 and not 1 as the boundary limit for TM in this pilot application was based on the decision to use the MED BACs and/or AEL BACs as thresholds. This is stricter approach given the one applied within the NEAT application for the Adriatic sub-region was based on use of the two thresholds i.e., the ADR BACs and MED EACs (see Annex I). In such manner, a balance is ensured regarding the use of different threshold values and classification categories for Cd, Hg and Pb, as well as a balance between GES classification categories set within the NEAT application in the Adriatic Sea Sub-region and CHASE+ methodology application in the Levantine Sea Basin (see Annex I). By setting the boundary limit at 1.5[6], the GES status is possible for some of the measured concentrations above the values of BACs used as thresholds.

24. A slightly different classification, where Green= NPAgood (CR or CS =0.5-2.0); and Yellow= PAmoderate (CR or CS =2.0-5.0) was recommended for PAHs and PCBs. This is a more lenient classification than with boundary limit of 1.5, that allows values twice the BAC threshold values, i.e. boundary limit of 2, to be considered NPA (or in GES)[7]. This more lenient classification is proposed due

[5] If the measured concentration equals the threshold, i.e. measured concentration = 1 BAC, the contamination ratio CR is 1. In this case, if the boundary limit between GES and non-GES is set at value 1, then the threshold would be the maximal measured concentration allowed for the station still to be in GES.
[6] If the measured concentration equals 1.5 x threshold, i.e. measured concentration = 1.5 BAC, the contamination ratio CR is 1.5. In this case, 1.5 BAC would be the maximal measured concentration allowed for the station still to be in GES. This is a more lenient approach than setting 1 as the boundary limit between GES and non-GES.
[7] For CR equals to 2, the measured concentration should be equal to twice the threshold, i.e. measured concentration = 2xBAC. Therefore, the boundary limit between GES and non-GES would be twice the threshold. That means that the 2x threshold (BAC) is the maximal measured concentration allowed for the station to be in GES.

to more limited data availability for PAHs and organochlorinated contaminants compared to TM in the Levantine Sea Basin. Moreover, this is proposed due to different interrelation of the BACs and EACs values for the organic contaminants compared to their interrelations for TM that were used to set GES classification categories for the application of the NEAT methodology in the Adriatic Sea Sub-region (see Annex I).

25. These two classifications schemes were performed twice, once using the proposed updated regional MED_BACs and for comparison, using the proposed updated sub-regional AEL_BACs when available (See section 4.3).

26. Further to the above-proposed boundary limits between the GES and non-GES status, it is important to recognize that the stricter approach in setting GES and non-GES classes for assessment of the Levantine Sea Basin was applied to compensate for the lack of data that prevented the use of NEAT. The NEAT methodology ensures optimal integration and aggregation of the assessment results in line with the nesting approach of IMAP. The present application of CHASE+ methodology in the Levantine Sea Basin was provided without spatial integration and aggregation of the areas of assessment and assessment results. Instead, aggregation of measured concentrations of the contaminants to calculate a contamination score (CS) was undertaken along with application of stricter boundary limits. However, aggregation to CS values was possible just for TM in sediments and *M. barbatus*.

27. In order to avoid a bias in the Mediterranean regional assessment, the comparison of the assessment findings between different sub-regions/areas should be further explored in order to provide additional inter-comparison of the results if needed. In that respect, it should be noted that the present work includes inter-comparison of different approaches applied for setting GES and non-GES classes in the Adriatic Sea Sub-region and the Levantine Sea Basin. The Secretariat undertakes further steps to analyze the inter-comparison of the assessment results in these two different areas, as a model for assessments that will be undertaken in other sub-regions/areas.

28. Table 4 summarizes the results of the CHASE+ application, while Annex II presents the tables with the colour coded results for each measured parameter at each station and matrix. Colour coded maps of selected results are presented in Annex III.

Table 4. 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/MED WG.533/3; UNEP/MED WG.533/Inf.3). In parenthesis, there are number of data points and their percentage from the total number of data points, classified using the proposed new AEL_BACs.

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 =0.5-1.5**	**CS =1.5-5**	**CS =5-10**	**CS >10**
*Cd, Hg, Pb	150	24 (19)	56 (43)	70 (86)	0 (2)	0 (0)
% from total number of data points		*16 (13)*	*37 (29)*	*47 (57)*	*0 (1)*	*0 (0)*

		CR=0.0-0.5	CR=0.5-2.0	CR =2-5	CR =5-10	CR>10
Σ_{16} PAHs	71	28 (14)	33 (45)	6 (7)	4 (1)	0 (4)
% from total number of data points		*39 (20)*	*47 (63)*	*8 (10)*	*6 (1)*	*0 (6)*
Σ_7 PCBs	52	39	6	4	1	2
% from total number of data points		*75*	*11*	*8*	*2*	*4*
M. barbatus						
		CS=0.0-0.5	**CS =0.5-1.5**	**CS =1.5-5**	**CS =5-10**	**CS >10**
$^+$Cd, Hg, Pb	87	39 (32)	43 (50)	5 (5)	0 (0)	0 (0)
% from total number of data points		*45 (37)*	*49 (57)*	*6 (6)*	*0 (0)*	*0 (0)*

*Without anomalous Cd concentrations for Cyprus; $^+$Without Cd for Israel, in 2015. All data were below detection limit of 17.5 μg/kg wet wt, a value that is much higher than the proposed MED_BAC and AEL_BAC (7.8 and 7.2 μg/kg wet wt, respectively)

29. Analysis of TM in sediments using CHASE+ with MED_BAC to calculate CR followed by CS calculation and using 1.5 as the boundary limit between NPA and Pa status (i.e., in GES and non-GES) showed that 47% of the stations were in the moderate (i.e., in yellow colour coded PA, non GES) status and 53% in GES. It should be mentioned that the yellow colour coded status is the least affected status among the 3 PA (non-GES) classification. Examination of the CRs for the individual metals, using the results for MED_BACs as threshold, found that Hg (24% of the data non-GES), followed by Cd (21% of the data non-GES), were the main factors influencing the classification.

30. A detailed examination of the contamination scores (CS) found that the stations classified as yellow colour coded status in Cyprus were Agkirovolio HS, Amathounta, Vasilikos HS and Larnaca west all sampled in 2017 and the station Latsi, sampled at 4 different years. Pb concentration in sediments was the main element contributing to this classification. In Israel, the area classified as moderate (i.e., in yellow colour coded) status was Haifa Bay and the main element contributing to this classification was Hg. The area is known to be still contaminated by Hg, even though there was a vast improvement following pollution abatement measures (Herut et al, 2016, 2021). In Lebanon, the main area in yellow colour coded status was Beirut, in particular the Dora region, followed by North Lebanon, with Cd and Hg contributing equally for the moderate classification. The Beirut area is densely populated and industrialized (Ghosn et al., 2020). In Turkey, 4 stations in 2015 and 14 stations in 2018 were classified as moderate (i.e., in yellow colour coded) status. In 2015 Pb and Hg contributed to this classification while in 2018 Cd was the main element contributing to this classification. No specific areas, defining the moderate status, were identified in Turkey.

31. The same analysis using as threshold AEL_BAC to calculate CRs followed by CS calculation found 57% of the stations in the moderate status i.e., in yellow coded -classification, and 1% in the poor

(i.e., in brown colour coded) status, both classified as PA-non GES, while 42% of the stations were in GES. Examination of the CRs for the individual metals, found that Hg (33% of the data were non-GES), followed by Cd (31% of the data were non-GES), were the main factors influencing the classification. Further using the contamination score (CS) found 18 more non-GES stations compared to the assessment using MED_BACs.

32. Only 53 % of the stations (using MED_BACs) or 42% of the stations (using AEL_BACS) were in GES concerning TM in sediments. These percentages are less than the recommended 75% to assign the whole area as in GES. Therefore, the Levantine Sea Basin should be classified as non-GES for TM in sediments, but in the moderate (i.e., yellow color coded) classification. Nevertheless, it should be taken into account that specific hot spot areas were identified in the Levantine Sea Basin. Additional recent data would improve the assessment and add confidence to it, better delimiting the hot-spot areas and allowing for spatial assessment units to be defined, as in the Adriatic Sea.

33. Analysis of Σ_{16} PAHs in sediments using CHASE+ with MED_BAC to calculate CR and 2 as the boundary limit between NPA and PA (in GES and non-GES) showed that 86% of the stations were in the NPA (i.e., in GES) status and 14 % PA (i.e., in non-GES), with 6 stations classified as yellow colour coded status and 4 as brown colour coded status. No station was classified as red colour coded status.

34. The use of AEL_BAC slightly reduced the percentage of the NPA stations to 83% and increased the percentage of PA stations to 17%. In this case, 7 stations were classified as yellow, 1 as brown and 4 as red colour coded status. It should be noted that use of the sub-regional threshold values (AEL_BAC in this case) should be considered more accurate. There was no large specific area with non-GES status. Only two small, geographically limited areas with non_GES status were detected. One such area was 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. Data on Σ_{16} PAHs in sediments were available only for these two countries. In this case, more than 75% of the stations were in GES, therefore the sea areas of Israel and Lebanon could be assessed as in GES for Σ_{16} PAH in sediments. Given the limited data availability no conclusion could be provided on GES status at the level of the Levantine Sea Basin.

35. Analysis of Σ_7 PCBs in sediments using CHASE+ was performed with threshold equal to 3 times the calculated BC value for the Mediterranean Sea (Table 2). Using it to calculate CR and 2 as the boundary limit between NPA and PA (in GES and non-GES) status showed that 86% of the stations were in the NPA status and 14% PA status, with 4 stations classified as moderate (i.e., in yellow colour coded), one poor (i.e. in brown colour coded) and 2 bad (i.e., in red colour coded) statuses. No specific area with non-GES status was detected, only localized hot spot off Beirut.

36. In this case, more than 75% of the stations were in GES, therefore Turkey and Lebanon could be assessed as in GES for Σ_7 PCBs in sediments. Given the limited data availability no conclusion could be provided on GES status at the level of the Levantine Sea Basin.

37. Analysis of TM in *M. barbatus* using CHASE+ with MED_BAC to calculate CR and 1.5 as the boundary limit between NPA and PA (in GES and non-GES) statuses showed that 94% of the samples were in the NPA (i.e., in GES) status and 6% PA (i.e., in non-GES, 5 samples) statuses, all of the latter on the moderate (i.e. in yellow colour coded) classification. The main factor influencing this classification was Hg. No samples were classified as brown or red colour coded statuses. Use of AEL_BAC did not change the percentage of the NPA samples, just changed the division between the blue and green classes, both in GES. The five samples in the yellow classification were from one station in Turkey (Anamur/Mersin) collected in 2015 and may not represent the status in 2022.

38. As more than 75% of the stations were in GES concerning TM in *M. barbatus*, and they encompassed a large area of the Levantine Sea Basin, it can be tentatively concluded that the whole basin is in GES. However, Hg concentrations should be further monitored. Moreover, recent data form Turkey,

as well as data from additional countries from Levantine Sea Basin are needed to improve this assessment.

6. Key findings

39. Comparison between the results of the traffic light and CHASE+ methodologies showed that the latter was stricter and lead to the identification of possible hot spot areas for certain contaminants.

40. The traffic light methodology applied to TM in sediments assigned a GES status to the majority of stations, excluding 3 stations in Cyprus (affected by Pb), Haifa Bay in Israel (affected by Hg), and 2 stations in Beirut, Lebanon (affected by Hg). In the assessment using CHASE+, the Levantine Sea Basin was classified as non-GES, in the yellow moderate (yellow color coded) classification status.

41. The traffic light methodology applied to Σ_{16} PAHs and Σ_7 PCBs in sediments assigned a GES status to all stations sampled. In the assessment using CHASE+ most of the stations (83-86%, depending on the parameter and the BAC used) were in GES. Given the limited data availability no conclusion could be provided for the whole Levantine Sea Basin. It was possible to determine that Israel and Lebanon are in GES concerning to Σ_{16} PAHs and Lebanon and Turkey are in GES concerning Σ_7 PCBs in sediments.

42. The traffic light methodology applied to TM in *M. barbatus* assigned a GES status to all samples. The CHASE+ methodology found that 94% of the samples were in GES, and therefore it was tentatively concluded that the whole basin is in GES for TM in *M. barbatus.* However, Hg concentrations should be further monitored. Moreover, recent data form Turkey, as well as data from other countries from the Levantine Sea Basin are needed to improve this assessment for *M. barbatus.*

Annex I

Comparison between the thresholds used in the CHASE+ application in the Levantine basin and the thresholds used in the NEAT application in the Adriatic sub-region

The two pilot GES assessments were performed applying the new proposed updated criteria: one in the Levantine Sea Basin as provided in the present document and one in the Adriatic Sea as provided in UNEP/MED WG.533/5; UNEP/MED WG.533/Inf.4; UNEP/MED WG.533/Inf. 5. CHASE+ was applied in the Levantine Sea Basin and the NEAT in the Adriatic Sea Sub-region.

The thresholds used for the NEAT application in the Adriatic Sea Sub-region and CHASE+ in the Levantine Sea Basin are presented in Table AI.1. In the NEAT application, the boundary limit between GES and non-GES was the MedEAC. A further division of the non-GES classification category was achieved by applying 3xMedEAC, that delimits between moderate and poor and bad GES assessment categories. The rational for this classification is provided in the documents UNEP/MED WG.533/5; UNEP/MED WG.533/Inf.4. In the application of CHASE+, the boundary limit delimiting between GES and non-GES was the 1.5 x MED_BAC[8] for TM in sediments and *M. barbatus*, and 2 x MED_BAC[9] for Σ_{16} PAHs and Σ_7 PCBs in sediments. A further division of the non-GES category was 5xMED_BAC and 10xMED_BAC, that delimits between moderate and poor, and between poor and bad GES assessment categories, respectively.

To compare with the NEAT boundary limits, the values used in CHASE+ were calculated as a fraction of MedEACs (Table AI.2). It can be seen that only for Hg and Pb in sediments, the boundary limits of the two assessment methodologies were similar. All the other boundary limits were much lower i.e., stricter in the CHASE+ pilot application in the Levantine Sea Basin.

The reason to apply the stricter boundary limits for the Levantine Sea Basin was to compensate for the lack of data, and hence a less confident assessment. In addition, this approach compensates for the lack of applying spatial integration and aggregation as required for nesting of the assessment areas and assessment results within IMAP implementation that is applied in the Adriatic Sea Sub-region by testing the NEAT methodology that requires a larger quantum of data than available in the Levantine Sea Basin. A stricter environmental classification boundary limits allowed for possible problem areas or hot spots to be pinpointed and marked for future additional assessment when more data will be available. If the higher MedEACs were used instead of BACs, such potential problem areas would be masked and not detected.

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[8] Or AEL_BAC. The assessment was performed twice, using both thresholds: MED_BACs and AEL_BACs. For Σ_7 PCBs only one threshold was available (Table AI.2).

[9] If the measured concentration equals 1.5 x threshold, i.e. measured concentration = 1.5 BAC, the contamination ratio CR is 1.5. In this case, 1.5 BAC would be the maximal measured concentration allowed for the station still to be in GES. This is a more lenient approach than setting 1 as the boundary limit between GES and non-GES.
For CR equals to 2, the measured concentration should be equal to twice the threshold, i.e. measured concentration = 2xBAC. Therefore, the boundary limit between GES and non-GES would be twice the threshold. That means that the 2x threshold (BAC) is the maximal measured concentration allowed for the station to be in GES.

Table AI.1. Comparison among the GESclassification categories and boundary limits used in the pilot GES assessments of the Adriatic Sea (using NEAT) and the Levantine Sea Basin (using CHASE+).

	GES		**non-GEs**		
IMAP – traffic light approach (Adriatic and Levantine)	Good	Moderate	Bad		
NEAT`s use for IMAP (Adriatic)	High	Good	Moderate	Poor	Bad
	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤MedEAC	MedEAC<meas. conc. ≤ 3xMedEAC	3xMedEAC<meas. conc. ≤ max. conc.	
Boundary limits	0				Max. conc.
Thresholds	BAC	MedEAC	3xMedEAC		
CHASE+ use for the Levantine Sea Basin	High	Good	Moderate	Poor	Bad
	CRorCS=0.0-0.5	**CRorCS =0.5-1.5**	**CRorCS =1.5-5**	**CRorCS =5-10**	**CRorCS >10**
TM in sediments and *M. barbatus*	Meas.conc<0.5 BAC	1.5 BAC<meas. Conc<0.5BAC	5xBAC<meas. Conc<1.5 BAC	10x BAC<meas. Conc< 5x BAC	Meas.conc>10x BAC
	CR=0.0-0.5	**CR =0.5-2.0**	**CR =2-5**	**CR =5-10**	**CR >10**
Σ_{16} PAHs and Σ_7 PCBs in sediment	Meas.conc<0.5 BAC	2BAC<meas. Conc<0.5BAC	5xBAC<meas. Conc<2BAC	10x BAC<meas. Conc< 5x BAC	Meas.conc>10x BAC

*Meas.conc – measured concentration

Table AI.2. Threshold concentrations and boundary limits used in the CHASE+ assessment of the Levantine Sea Basin. In red, the ratio between the boundary limit used in the Levantine Sea Basin and MedEAC.

	BAC_MED	**BAC_AEL**	**MedEAC**	**1.5xBAC**		**5xBAC**		**10xBAC**	
Sediments, µg/kg dry wt				**MED**	**AEL**	**MED**	**AEL**	**MED**	**AEL**
Cd	161	118	1200	242	177	805	590	1610	1180
				0.2	0.15	0.7	0.5	1.3	1.0
Hg	75	47.3	150	113	71	375	236.5	750	473
				0.8	0.5	2.5	1.6	5.0	3.2
Pb	22500	23511	46700	33750	35267	112500	117555	225000	235110

				0.7	0.8	2.4	2.5	4.8	5.0
				2xBAC		**5xBAC**		**10xBAC**	
				MED	**AEL**	**MED**	**AEL**	**MED**	**AEL**
Σ_{16} PAHs	32	41	4022	64	82	160	205	320	410
				0.02	0.02	0.04	0.1	0.1	0.01
Σ_{7} PCBs	1.2		68	2.4		6		12	
				0.04		0.1		0.2	
***M. barbatus*, µg/kg wet wt**									
				1.5xBAC		**5xBAC**		**10xBAC**	
				MED	**AEL**	**MED**	**AEL**	**MED**	**AEL**
Cd	7.8	7.2	50	12	11	39	36	78	72
				0.2	0.2	0.8	0.7	1.6	1.4
Hg	81.2	67.4	1000	122	101	406	337	812	674
				0.1	0.1	0.4	0.3	0.8	0.7
Pb	36.6	27	300	55	41	183	135	366	270
				0.2	0.1	0.6	0.5	1.2	0.9

Annex II

The results of application of the IMAP Traffic Light and the CHASE+ methodologies

Table A2.1. Results of the "traffic light" approach to assess the environmental status of TM in sediments in the Levantine Sea Basin. In green, values below BACs; in yellow, values between BAC and MED_EAC; in red values above the MED_EAC. Green and yellow stations are considered in GES, and red stations as non-GES. Cd concentrations in Cyprus were not classified (see table 3).

Source	IMAP _File	Country	Area	Station	Year	Cd MEDBAC	Hg MEDBAC	Pb MEDBAC		Cd AELBAC	Hg AELBAC	Pb AELBAC
IMAP	125	Cyprus	Agkirovolio HS	CY_12-C2_O1/B4	2017		15	53400			15	53400
IMAP	125	Cyprus	Agkirovolio HS	CY_12-C2_O1/B4	2018		15	38000			15	38000
IMAP	125	Cyprus	Amathounta	CY_12-C2_O4/B4	2017		15	43500			15	43500
IMAP	125	Cyprus	Amathounta	CY_12-C2_O4/B4	2018		15	37000			15	37000
IMAP	125	Cyprus	Cavo Greco	CY_22-C3_S1/B4	2014		15	4600			15	4600
IMAP	125	Cyprus	Cavo Greco	CY_22-C3_S1/B4	2017		15	11000			15	11000
IMAP	125	Cyprus	Cavo Greco	CY_22-C3_S1/B4	2018		15	5000			15	5000
IMAP	125	Cyprus	Larnaca East	CY_18-C2_S1/B4	2016		15	37100			15	37100
IMAP	125	Cyprus	Larnaca East	CY_18-C2_S1/B4	2017		15	42200			15	42200
IMAP	125	Cyprus	Larnaca East	CY_18-C2_S1/B4	2018		15	32000			15	32000
IMAP	125	Cyprus	Larnaca West	CY_16-C2_S1/B4	2016		15	37900			15	37900
IMAP	125	Cyprus	Larnaca West	CY_16-C2_S1/B4	2017		30	47600			30	47600
IMAP	125	Cyprus	Latsi	CY_3-C2_S1/LT4	2013		15	45400			15	45400
IMAP	125	Cyprus	Latsi	CY_3-C2_S1/LT4	2013		15	47200			15	47200
IMAP	125	Cyprus	Latsi	CY_3-C2_S1/LT4	2015		15	47200			15	47200
IMAP	125	Cyprus	Latsi	CY_3-C2_S1/LT4	2017		15	53900			15	53900
IMAP	125	Cyprus	Polis Limni HS	CY_03-C2-PS	2015		15	24500			15	24500
IMAP	125	Cyprus	Vasilikos HS	CY_14-C2_S1/B4	2014		15	4700			15	4700
IMAP	125	Cyprus	Vasilikos HS	CY_14-C2_S1/B4	2015		15	4700			15	4700
IMAP	125	Cyprus	Vasilikos HS	CY_14-C2_S1/B4	2017		15	44200			15	44200
IMAP	125	Cyprus	Vasilikos-EAC HS	CY_14-C2_S1/PS	2014		15	31000			15	31000
IMAP	125	Cyprus	Vasilikos-EAC HS	CY_14-C2_S1/PS	2014		15	1400			15	1400
MEDPOL		Israel		ISRMH0	2015	303.0	216.7	10561		303.0	216.7	10561
MEDPOL		Israel		ISRMH0	2017	140.4	53.7	5874		140.4	53.7	5874
MEDPOL		Israel	Haifa Bay	ISRTMH1	2015	50.0	283.3	5460		50.0	283.3	5460
MEDPOL		Israel	Haifa Bay	ISRTMH1	2017	39.7	256.9	6543		39.7	256.9	6543
IMAP	410	Israel	Haifa Bay	ISRTMH1	2019	209.8	291.3	5295		209.8	291.3	5295
IMAP		Israel	Haifa Bay	ISRTMH1	2020	29.9	283.6	5576		29.9	283.6	5576
MEDPOL		Israel	Haifa Bay	ISRTMH2	2015	50.0	279.6			50.0	279.6	
IMAP	410	Israel	Haifa Bay	ISRTMH2	2019	55.8	316.3	4411		55.8	316.3	4411
IMAP		Israel	Haifa Bay	ISRTMH2	2020	29.8	277.3	6243		29.8	277.3	6243
MEDPOL		Israel		ISRMH3	2015	426.4	171.0	12993		426.4	171.0	12993
MEDPOL		Israel		ISRMH3	2017	122.5	50.4	6635		122.5	50.4	6635
MEDPOL		Israel	Haifa Bay	ISRTMH8	2015	50.0	229.2	5752		50.0	229.2	5752
MEDPOL		Israel	Haifa Bay	ISRTMH8	2017	69.0	222.0	5653		69.0	222.0	5653
IMAP	410	Israel	Haifa Bay	ISRTMH8	2019	52.9	226.5	5426		52.9	226.5	5426
IMAP		Israel	Haifa Bay	ISRTMH8	2020	13.9	183.2	5883		13.9	183.2	5883
MEDPOL		Israel	Haifa Bay	ISRTMH9	2015	50.0	257.0	5607		50.0	257.0	5607
MEDPOL		Israel	Haifa Bay	ISRTMH9	2017	34.5	240.5	5939		34.5	240.5	5939
IMAP	410	Israel	Haifa Bay	ISRTMH9	2019	52.1	242.1	4974		52.1	242.1	4974
IMAP		Israel	Haifa Bay	ISRTMH9	2020	23.7	280.0	6101		23.7	280.0	6101
MEDPOL		Israel	Haifa Bay	ISRTMH10	2015	50.0	230.7	6240		50.0	230.7	6240
IMAP	410	Israel	Haifa Bay	ISRTMH10	2019	58.9	204.1	4365		58.9	204.1	4365
IMAP		Israel	Haifa Bay	ISRTMH10	2020	31.8	257.0	5747		31.8	257.0	5747
MEDPOL		Israel	Haifa Bay	ISRTMH11	2015	86.0	206.5	6972		86.0	206.5	6972
MEDPOL		Israel	Haifa Bay	ISRTMH11	2017	46.4	212.5	5799		46.4	212.5	5799
IMAP	410	Israel	Haifa Bay	ISRTMH11	2019	71.1	187.0	4371		71.1	187.0	4371
IMAP_IS		Israel	Haifa Bay	ISRTMH11	2020	34.4	208.0	6380		34.4	208.0	6380
MEDPOL		Israel	Haifa Bay	ISRTMH12	2015	50.0	252.6	5515		50.0	252.6	5515
IMAP	410	Israel	Haifa Bay	ISRTMH12	2019	50.7	199.7	4175		50.7	199.7	4175
IMAP		Israel	Haifa Bay	ISRTMH12	2020	28.9	213.9	5734		28.9	213.9	5734
MEDPOL		Israel	Haifa Bay	ISRTMC14	2015	50.0	155.8	4897		50.0	155.8	4897
MEDPOL		Israel	Haifa Bay	ISRTMC14	2017	44.8	127.2	5011		44.8	127.2	5011

IMAP	410	Israel	Haifa Bay	ISRTMC14	2019	48.0	161.3	3995		48.0	161.3	3995
IMAP		Israel	Haifa Bay	ISRTMC14	2020	32.7	132.3	5777		32.7	132.3	5777
MEDPOL		Israel	Haifa Bay	ISRTMC18	2015	50.0	79.3	4802		50.0	79.3	4802
MEDPOL		Israel	Haifa Bay	ISRTMC18	2017	24.6	29.6	4038		24.6	29.6	4038
IMAP	410	Israel	Haifa Bay	ISRTMC18	2019	46.9	43.6	3744		46.9	43.6	3744
IMAP		Israel	Haifa Bay	ISRTMC18	2020	37.9	34.9	5192		37.9	34.9	5192
MEDPOL		Israel	Haifa Bay	ISRTMC22	2015	50.0	19.4	3849		50.0	19.4	3849
MEDPOL		Israel	Haifa Bay	ISRTMC22	2017	60.4	17.1	6725		60.4	17.1	6725
MEDPOL		Israel	Haifa Bay	ISRTMC23	2015	50.0	25.6	4451		50.0	25.6	4451
MEDPOL		Israel	Haifa Bay	ISRTMC23	2017	37.5	21.2	5123		37.5	21.2	5123
IMAP	410	Israel	Haifa Bay	ISRTMC23	2019	54.9	26.2	4192		54.9	26.2	4192
IMAP		Israel	Haifa Bay	ISRTMC23	2020	31.3	6.8	4740		31.3	6.8	4740
MEDPOL		Israel	Haifa Bay	ISRTMC26	2015	81.3	29.8	5417		81.3	29.8	5417
MEDPOL		Israel	Haifa Bay	ISRTMC26	2015	50.0	30.3	5109		50.0	30.3	5109
MEDPOL		Israel	Haifa Bay	ISRTMH27	2015	59.1	56.0	9831		59.1	56.0	9831
MEDPOL		Israel	Haifa Bay	ISRTMH27	2017	146.2	86.0	9000.3		146.2	86.0	9000.3
IMAP	410	Israel	Haifa Bay	ISRTMH27	2019	225.5	61.4	10177		225.5	61.4	10177
IMAP	410	Israel	Haifa Bay	ISRTMH27	2019	230.8	55.0	10857		230.8	55.0	10857
IMAP	410	Israel	Haifa Bay	ISRTMH27	2019	220.6	56.1	10802		220.6	56.1	10802
IMAP		Israel	Haifa Bay	ISRTMH27	2020	323.7	61.3	16750		323.7	61.3	16749.63
MEDPOL		Israel		ISRTMC39	2015	50.0	3.78	4015		50.0	3.78	4015
MEDPOL		Israel		ISRTMC39	2017	17.3	2.46	9041.8		17.3	2.46	9041.8
IMAP	410	Israel		ISRTMC39	2019	23.2	2.43	3101		23.2	2.43	3101
IMAP		Israel		ISRTMC39	2020	10.4	2.03	4081		10.4	2.03	4081
MEDPOL		Israel		ISRTMC43	2015	50.0	5.53	3568		50.0	5.53	3568
MEDPOL		Israel		ISRTMC43	2017	25.3	3.73	4150		25.3	3.73	4150
IMAP	410	Israel		ISRTMC43	2019	17.6	1.85	2391		17.6	1.85	2391
IMAP		Israel		ISRTMC43	2020	13.3	2.76	3595		13.3	2.76	3595
MEDPOL		Israel		ISRTMC49	2015	50.0	8.52	4003		50.0	8.52	4003
MEDPOL		Israel		ISRTMC49	2017	17.6	7.61	5005		17.6	7.61	5005
IMAP	410	Israel		ISRTMC49	2019	21.7	4.27	5839		21.7	4.27	5839
IMAP		Israel		ISRTMC49	2020	19.5	4.17	4901		19.5	4.17	4901
MEDPOL		Israel		ISRTMC55a	2015	50.0	3.20	2935		50.0	3.20	2935
IMAP	118	Lebanon	Beirut	DORA-100	2019	599	234	35387		599	234	35387
IMAP	118	Lebanon	Beirut	DORA-10	2019	510	150	27000		510	150	27000
IMAP	118	Lebanon	Beirut	DORA-30	2019	530	210	26792		530	210	26792
IMAP	118	Lebanon	Beirut	RAMLET-40	2019	320	100	21000		320	100	21000
IMAP	118	Lebanon	Tripoli-North Lebanon	TRI-60	2019	130	100	17418		130	100	17418
IMAP	118	Lebanon	Akkar-North Lebanon	AKK-60	2019	223	25	12129		223	25	12129
IMAP	118	Lebanon	Beirut	COSTA-60	2019	120	100	11200		120	100	11200
IMAP	118	Lebanon	Beirut	RAMLET-100	2019	280	100	11000		280	100	11000
IMAP	118	Lebanon	Akkar-North Lebanon	AKK-10	2019	349	100	8888		349	100	8888
IMAP	118	Lebanon	Saida area	SDA-60	2019	143	21	7971		143	21	7971
IMAP	118	Lebanon	Damour	DAM-60	2019	169	23	7862		169	23	7862
IMAP	118	Lebanon	Tripoli-North Lebanon	TRI-10	2019	116	100	6674		116	100	6674
IMAP	118	Lebanon	Beirut	COSTA-30	2019	134	100	6072		134	100	6072
IMAP	118	Lebanon	Saida area	SDA-10	2019	124	11	4309		124	11	4309
IMAP	118	Lebanon	Damour	DAM-10	2019	301	100	3884		301	100	3884
IMAP	118	Lebanon	Beirut	RAMLET-10	2019	266	100	3853		266	100	3853
IMAP	118	Lebanon	Byblos area	Nhr Ib	2019	270	100	3800		270	100	3800
Ghosn et al, 2020		Lebanon		(Tripoli)	2017	320	120	17300		320	120	17300
Ghosn et al, 2020		Lebanon		(Beirut)	2017		70	7250			70	7250
Ghosn et al, 2020		Lebanon		(Saida)	2017	130	70	3350		130	70	3350
MEDPOL		Turkey	MERSİN KÖRFEZİ	EUTMR6-3	2015	109	117	22302		109	117	22302
MEDPOL		Turkey	SKENDERUN KÖRFEZ	ISKSW2-3	2015	87	54	11923		87	54	11923
MEDPOL		Turkey	SKENDERUN KÖRFEZ	ISKSW3-3	2015	50	50	10838		50	50	10838
MEDPOL		Turkey	KARATAŞ	KARSW1-3	2015	101	64	18977		101	64	18977
MEDPOL		Turkey	MARMARİS	MARSW1-3	2015	44	66	27106		44	66	27106
MEDPOL		Turkey	SEYHAN AĞZI	SEYSW3-3	2015	99	56	32142		99	56	32142
MEDPOL		Turkey	YUMURTALIK	YUMSW1-3	2015	72	56	9886		72	56	9886
MEDPOL		Turkey	ANTALYA KÖRFEZİ	ANBSW1	2015	88	69	17943		88	69	17943
MEDPOL		Turkey	GÖKSU NEHRİ AĞZI	GRESW1	2015	88	54	7882		88	54	7882
MEDPOL		Turkey	SEYHAN AĞZI	SEYSW1	2015	102	68	30254		102	68	30254

MEDPOL		Turkey	TIRTAR	TIRSW1	2015	78	76	27355		78	76	27355
IMAP	445	Turkey	Akkuyu	AKKUYU	2018	383	39	14834		383	39	14834
IMAP	445	Turkey	Akıncı Burnu	AKNSW1	2018	201	27	14237		201	27	14237
IMAP	445	Turkey	Alanya	ALBSW1	2018	72	6	10131		72	6	10131
IMAP	445	Turkey	Anamur	ANASW1	2018	323	28	18193		323	28	18193
IMAP	445	Turkey	Anamur	ANASWR	2018	396	39	25048		396	39	25048
IMAP	445	Turkey	Antalya Bay	ANBSW1	2018	163	35	19697		163	35	19697
IMAP	445	Turkey	Antalya Bay	ANBSWR	2018	149	34	16410		149	34	16410
IMAP	445	Turkey	Botaş	BTCSW1	2018	250	56	26509		250	56	26509
IMAP	445	Turkey	Ceyhan River mouth	CEYSWR	2018	133	20	12174		133	20	12174
IMAP	445	Turkey	Dalaman River mouth	DALSW1	2018	104	62	7532		104	62	7532
IMAP	445	Turkey	Dalaman River mouth	DALSW2	2018	105	31	6138		105	31	6138
IMAP	445	Turkey	Dildare Burnu	DILSWR	2018	79	31	15204		79	31	15204
IMAP	445	Turkey		ECSW1	2018	134	39	11037		134	39	11037
IMAP	445	Turkey	Erdemli	ERDSWR	2018	186	31	19625		186	31	19625
IMAP	445	Turkey	Finike Bay	FIBSW1	2018	91	25	16703		91	25	16703
IMAP	445	Turkey	Göksu	GRESW1	2018	214	21	8016		214	21	8016
IMAP	445	Turkey	Göksu River mouth	GRESW2	2018	551	25	12603		551	25	12603
IMAP	445	Turkey	İskenderun Bay	ISKSW2	2018	134	65	9779		134	65	9779
IMAP	445	Turkey	İskenderun Bay	ISKSW3	2018	119	31	13526		119	31	13526
IMAP	445	Turkey	İskenderun Bay	ISKSWR	2018	211	32	23146		211	32	23146
IMAP	445	Turkey	Karataş	KARSW1	2018	127	18	14388		127	18	14388
IMAP	445	Turkey	Mersin Bay	MERSİN-DOGU-REF	2018	211	29	23536		211	29	23536
IMAP	445	Turkey	Mersin Bay	MERSWR	2018	250	36	21425		250	36	21425
IMAP	445	Turkey	Manavgat River mouth	MRESW1	2018	154	7	6407		154	7	6407
IMAP	445	Turkey	Mersin Bay	MRSYB6	2018	227	32	27886		227	32	27886
IMAP	445	Turkey	Samandağ	SAMSWR	2018	291	27	8445		291	27	8445
IMAP	445	Turkey	Seyhan River mouth	SEYSW1	2018	231	39	23561		231	39	23561
IMAP	445	Turkey	Seyhan River mouth	SEYSW2	2018	245	27	25471		245	27	25471
IMAP	445	Turkey	Seyhan River mouth	SEYSW3	2018	263	33	26303		263	33	26303
IMAP	445	Turkey	Taşucu	TASSW1	2018	478	25	14155		478	25	14155
IMAP	445	Turkey	Tırtar	TIRSW1	2018	263	45	22947		263	45	22947
IMAP	445	Turkey	İskenderun Bay	YUM-REF	2018	189	35	16510		189	35	16510
IMAP	445	Turkey	Yumurtalık	YUMSW1	2018	130	15	11547		130	15	11547

Table A2.2. Results of the CHASE+ approach to assess the environmental status of TM in sediments in the Levantine Sea Basin. Blue - NPAhigh (CS=0.0-0.5); Green- NPAgood (CS =0.5-1.5); Yellow-PAmoderate (CS =1.5-5.0); Brown - PApoor (CS =5.0-10.0) and Red - PAbad (CS > 10.0). Blue and green stations are considered in GES, yellow, brown and red stations are considered non-GES. Cd concentrations in Cyprus were not classified (see table 3).

Sourc	IMAP	Country	Area	Station	Year	Cd_CR=C measure	Hg_CR=C measure	Pb_CR=C measure	CS with MED_BA		_Cd_CR=C measure	Hg_CR=C measure	Pb_CR=C measure	CS with AEL_BA
IMAP	125	Cyprus	Agkirovolio	CY_12-	2017		0.20	2.37	1.82			0.32	2.27	1.83
IMAP	125	Cyprus	Agkirovolio	CY_12-	2018		0.20	1.69	1.34			0.32	1.62	1.37
IMAP	125	Cyprus	Amathounta	CY_12-	2017		0.20	1.93	1.51			0.32	1.85	1.53
IMAP	125	Cyprus	Amathounta	CY_12-	2018		0.20	1.64	1.30			0.32	1.57	1.34
IMAP	125	Cyprus	Cavo Greco	CY_22-	2014		0.20	0.20	0.29			0.32	0.20	0.36
IMAP	125	Cyprus	Cavo Greco	CY_22-	2017		0.20	0.49	0.49			0.32	0.47	0.56
IMAP	125	Cyprus	Cavo Greco	CY_22-	2018		0.20	0.22	0.30			0.32	0.21	0.37
IMAP	125	Cyprus	Larnaca	CY_18-	2016		0.20	1.65	1.31			0.32	1.58	1.34
IMAP	125	Cyprus	Larnaca	CY_18-	2017		0.20	1.88	1.47			0.32	1.79	1.49
IMAP	125	Cyprus	Larnaca	CY_18-	2018		0.20	1.42	1.15			0.32	1.36	1.19
IMAP	125	Cyprus	Larnaca	CY_16-	2016		0.20	1.68	1.33			0.32	1.61	1.36
IMAP	125	Cyprus	Larnaca	CY_16-	2017		0.40	2.12	1.78			0.63	2.02	1.88
IMAP	125	Cyprus	Latsi	CY_3-	2013		0.20	2.02	1.57			0.32	1.93	1.59
IMAP	125	Cyprus	Latsi	CY_3-	2013		0.20	2.10	1.62			0.32	2.01	1.64
IMAP	125	Cyprus	Latsi	CY_3-	2015		0.20	2.10	1.62			0.32	2.01	1.64
IMAP	125	Cyprus	Latsi	CY_3-	2017		0.20	2.40	1.84			0.32	2.29	1.85
IMAP	125	Cyprus	Polis Limni HS	CY_03-C2-PS	2015		0.20	1.09	0.91			0.32	1.04	0.96
IMAP	125	Cyprus	Vasilikos	CY_14-	2014		0.20	0.21	0.29			0.32	0.20	0.37

IMAP	125	Cyprus	Vasilikos	CY_14-	2015		0.20	0.21	0.29			0.32	0.20	0.37
IMAP	125	Cyprus	Vasilikos	CY_14-	2017		0.20	1.96	1.53			0.32	1.88	1.55
IMAP	125	Cyprus	Vasilikos-EAC	CY_14-	2014		0.20	1.38	1.12			0.32	1.32	1.16
IMAP	125	Cyprus	Vasilikos-EAC	CY_14-	2014		0.20	0.06	0.19			0.32	0.06	0.27
MEDPOL		Israel		ISRMH0	2015	1.9	2.89	0.47	3.03		2.6	4.59	0.45	4.38
MEDPOL		Israel		ISRMH0	2017	0.9	0.72	0.26	1.07		1.2	1.14	0.25	1.48
MEDPOL		Israel	Haifa Bay	ISRTMH1	2015	0.3	3.78	0.24	2.50		0.4	6.00	0.23	3.84
MEDPOL		Israel	Haifa Bay	ISRTMH1	2017	0.2	3.43	0.29	2.29		0.3	5.44	0.28	3.49
IMAP	410	Israel	Haifa Bay	ISRTMH1	2019	1.3	3.88	0.24	3.13		1.8	6.17	0.23	4.71
IMAP		Israel	Haifa Bay	ISRTMH1	2020	0.2	3.78	0.25	2.43		0.3	6.00	0.24	3.75
MEDPOL		Israel	Haifa Bay	ISRTMH2	2015	0.3	3.73		2.86		0.4	5.92		4.48
IMAP	410	Israel	Haifa Bay	ISRTMH2	2019	0.3	4.22	0.20	2.75		0.5	6.69	0.19	4.25
IMAP		Israel	Haifa Bay	ISRTMH2	2020	0.2	3.70	0.28	2.40		0.3	5.87	0.27	3.69
MEDPOL		Israel		ISRMH3	2015	2.7	2.28	0.58	3.18		3.6	3.62	0.55	4.49
MEDPOL		Israel		ISRMH3	2017	0.8	0.67	0.29	1.00		1.0	1.07	0.28	1.38
MEDPOL		Israel	Haifa Bay	ISRTMH8	2015	0.3	3.06	0.26	2.09		0.4	4.85	0.24	3.19
MEDPOL		Israel	Haifa Bay	ISRTMH8	2017	0.4	2.96	0.25	2.10		0.6	4.70	0.24	3.19
IMAP	410	Israel	Haifa Bay	ISRTMH8	2019	0.3	3.02	0.24	2.07		0.4	4.79	0.23	3.16
IMAP		Israel	Haifa Bay	ISRTMH8	2020	0.1	2.44	0.26	1.61		0.1	3.88	0.25	2.45
MEDPOL		Israel	Haifa Bay	ISRTMH9	2015	0.3	3.43	0.25	2.30		0.4	5.44	0.24	3.52
MEDPOL		Israel	Haifa Bay	ISRTMH9	2017	0.2	3.21	0.26	2.13		0.3	5.09	0.25	3.25
IMAP	410	Israel	Haifa Bay	ISRTMH9	2019	0.3	3.23	0.22	2.18		0.4	5.12	0.21	3.33
IMAP		Israel	Haifa Bay	ISRTMH9	2020	0.1	3.73	0.27	2.40		0.2	5.93	0.26	3.69
MEDPOL		Israel	Haifa Bay	ISRTMH10	2015	0.3	3.08	0.28	2.12		0.4	4.88	0.27	3.22
IMAP	410	Israel	Haifa Bay	ISRTMH10	2019	0.4	2.72	0.19	1.89		0.5	4.32	0.19	2.89
IMAP		Israel	Haifa Bay	ISRTMH10	2020	0.2	3.43	0.26	2.24		0.3	5.44	0.24	3.44
MEDPOL		Israel	Haifa Bay	ISRTMH11	2015	0.5	2.75	0.31	2.08		0.7	4.37	0.30	3.11
MEDPOL		Israel	Haifa Bay	ISRTMH11	2017	0.3	2.83	0.26	1.95		0.4	4.50	0.25	2.96
IMAP	410	Israel	Haifa Bay	ISRTMH11	2019	0.4	2.49	0.19	1.81		0.6	3.96	0.19	2.74
IMAP_IS		Israel	Haifa Bay	ISRTMH11	2020	0.2	2.77	0.28	1.89		0.3	4.40	0.27	2.87
MEDPOL		Israel	Haifa Bay	ISRTMH12	2015	0.3	3.37	0.25	2.27		0.4	5.35	0.23	3.47
IMAP	410	Israel	Haifa Bay	ISRTMH12	2019	0.3	2.66	0.19	1.83		0.4	4.23	0.18	2.79
IMAP		Israel	Haifa Bay	ISRTMH12	2020	0.2	2.85	0.25	1.90		0.2	4.53	0.24	2.90
MEDPOL		Israel	Haifa Bay	ISRTMC14	2015	0.3	2.08	0.22	1.51		0.4	3.30	0.21	2.27
MEDPOL		Israel	Haifa Bay	ISRTMC14	2017	0.3	1.70	0.22	1.27		0.4	2.69	0.21	1.90
IMAP	410	Israel	Haifa Bay	ISRTMC14	2019	0.3	2.15	0.18	1.52		0.4	3.41	0.17	2.30
IMAP		Israel	Haifa Bay	ISRTMC14	2020	0.2	1.76	0.26	1.28		0.3	2.80	0.25	1.92
MEDPOL		Israel	Haifa Bay	ISRTMC18	2015	0.3	1.06	0.21	0.91		0.4	1.68	0.20	1.33
MEDPOL		Israel	Haifa Bay	ISRTMC18	2017	0.2	0.39	0.18	0.42		0.2	0.63	0.17	0.58
IMAP	410	Israel	Haifa Bay	ISRTMC18	2019	0.3	0.58	0.17	0.60		0.4	0.92	0.16	0.85
IMAP		Israel	Haifa Bay	ISRTMC18	2020	0.2	0.47	0.23	0.54		0.3	0.74	0.22	0.74
MEDPOL		Israel	Haifa Bay	ISRTMC22	2015	0.3	0.26	0.17	0.43		0.4	0.41	0.16	0.58
MEDPOL		Israel	Haifa Bay	ISRTMC22	2017	0.4	0.23	0.30	0.52		0.5	0.36	0.29	0.67
MEDPOL		Israel	Haifa Bay	ISRTMC23	2015	0.3	0.34	0.20	0.49		0.4	0.54	0.19	0.67
MEDPOL		Israel	Haifa Bay	ISRTMC23	2017	0.2	0.28	0.23	0.43		0.3	0.45	0.22	0.57
IMAP	410	Israel	Haifa Bay	ISRTMC23	2019	0.3	0.35	0.19	0.51		0.5	0.55	0.18	0.69
IMAP		Israel	Haifa Bay	ISRTMC23	2020	0.2	0.09	0.21	0.29		0.3	0.14	0.20	0.35
MEDPOL		Israel	Haifa Bay	ISRTMC26	2015	0.5	0.40	0.24	0.66		0.7	0.63	0.23	0.89
MEDPOL		Israel	Haifa Bay	ISRTMC26	2015	0.3	0.40	0.23	0.54		0.4	0.64	0.22	0.74
MEDPOL		Israel	Haifa Bay	ISRTMH27	2015	0.4	0.75	0.44	0.90		0.5	1.19	0.42	1.21
MEDPOL		Israel	Haifa Bay	ISRTMH27	2017	0.9	1.15	0.40	1.42		1.2	1.82	0.38	1.98
IMAP	410	Israel	Haifa Bay	ISRTMH27	2019	1.4	0.82	0.45	1.54		1.9	1.30	0.43	2.10
IMAP	410	Israel	Haifa Bay	ISRTMH27	2019	1.4	0.73	0.48	1.53		2.0	1.16	0.46	2.06
IMAP	410	Israel	Haifa Bay	ISRTMH27	2019	1.4	0.75	0.48	1.50		1.9	1.19	0.46	2.03
IMAP		Israel	Haifa Bay	ISRTMH27	2020	2.0	0.82	0.74	2.07		2.7	1.30	0.71	2.74
MEDPOL		Israel		ISRTMC39	2015	0.3	0.05	0.18	0.31		0.4	0.08	0.17	0.39
MEDPOL		Israel		ISRTMC39	2017	0.1	0.03	0.40	0.31		0.1	0.05	0.38	0.34
IMAP	410	Israel		ISRTMC39	2019	0.1	0.03	0.14	0.18		0.2	0.05	0.13	0.22
IMAP		Israel		ISRTMC39	2020	0.1	0.03	0.18	0.16		0.1	0.04	0.17	0.18
MEDPOL		Israel		ISRTMC43	2015	0.3	0.07	0.16	0.31		0.4	0.12	0.15	0.40
MEDPOL		Israel		ISRTMC43	2017	0.2	0.05	0.18	0.23		0.2	0.08	0.18	0.27
IMAP	410	Israel		ISRTMC43	2019	0.1	0.02	0.11	0.14		0.1	0.04	0.10	0.17
IMAP		Israel		ISRTMC43	2020	0.1	0.04	0.16	0.16		0.1	0.06	0.15	0.19
MEDPOL		Israel		ISRTMC49	2015	0.3	0.11	0.18	0.35		0.4	0.18	0.17	0.45
MEDPOL		Israel		ISRTMC49	2017	0.1	0.10	0.22	0.25		0.1	0.16	0.21	0.30
IMAP	410	Israel		ISRTMC49	2019	0.1	0.06	0.26	0.26		0.2	0.09	0.25	0.30
IMAP		Israel		ISRTMC49	2020	0.1	0.06	0.22	0.23		0.2	0.09	0.21	0.27
MEDPOL		Israel		ISRTMC55a	2015	0.3	0.04	0.13	0.28		0.4	0.07	0.12	0.36
IMAP	118	Lebanon	Beirut	DORA-100	2019	3.7	3.12	1.57	4.86		5.1	4.95	1.51	6.65
IMAP	118	Lebanon	Beirut	DORA-10	2019	3.2	2.00	1.20	3.68		4.3	3.17	1.15	4.98
IMAP	118	Lebanon	Beirut	DORA-30	2019	3.3	2.80	1.19	4.21		4.5	4.44	1.14	5.81
IMAP	118	Lebanon	Beirut	RAMLET-40	2019	2.0	1.33	0.93	2.46		2.7	2.12	0.89	3.30
IMAP	118	Lebanon	Tripoli-North	TRI-60	2019	0.8	1.33	0.77	1.68		1.1	2.12	0.74	2.29
IMAP	118	Lebanon	Akkar-North	AKK-60	2019	1.4	0.33	0.54	1.31		1.9	0.53	0.52	1.69
IMAP	118	Lebanon	Beirut	COSTA-60	2019	0.7	1.33	0.50	1.49		1.0	2.12	0.48	2.08

IMAP	118	Lebanon	Beirut	RAMLET-100	2019	1.7	1.33	0.49	2.06		2.4	2.12	0.47	2.86
IMAP	118	Lebanon	Akkar-North	AKK-10	2019	2.2	1.33	0.40	2.25		3.0	2.12	0.38	3.15
IMAP	118	Lebanon	Saida area	SDA-60	2019	0.9	0.28	0.35	0.88		1.2	0.44	0.34	1.15
IMAP	118	Lebanon	Damour	DAM-60	2019	1.1	0.31	0.35	0.99		1.4	0.49	0.33	1.30
IMAP	118	Lebanon	Tripoli-North	TRI-10	2019	0.7	1.33	0.30	1.36		1.0	2.12	0.28	1.96
IMAP	118	Lebanon	Beirut	COSTA-30	2019	0.8	1.33	0.27	1.41		1.1	2.12	0.26	2.03
IMAP	118	Lebanon	Saida area	SDA-10	2019	0.8	0.15	0.19	0.64		1.0	0.23	0.18	0.85
IMAP	118	Lebanon	Damour	DAM-10	2019	1.9	1.33	0.17	1.95		2.5	2.12	0.17	2.79
IMAP	118	Lebanon	Beirut	RAMLET-10	2019	1.7	1.33	0.17	1.82		2.2	2.12	0.16	2.62
IMAP	118	Lebanon	Byblos area	Nhr Ib	2019	1.7	1.33	0.17	1.84		2.3	2.12	0.16	2.63
Lit Ghosn		Lebanon		(Tripoli)	2017	2.0	1.60	0.77	2.52		2.7	2.54	0.74	3.45
Lit Ghosn		Lebanon		(Beirut)	2017		0.93	0.32	0.89			1.48	0.31	1.27
Lit Ghosn		Lebanon		(Saida)	2017	0.8	0.93	0.15	1.09		1.1	1.48	0.14	1.57
MEDPOL		Turkey	MERSİN	EUTMR6-3	2015	0.7	1.56	0.99	1.87		0.9	2.48	0.95	2.51
MEDPOL		Turkey	SKENDERUN	ISKSW2-3	2015	0.5	0.72	0.53	1.04		0.7	1.15	0.51	1.38
MEDPOL		Turkey	SKENDERUN	ISKSW3-3	2015	0.3	0.67	0.48	0.84		0.4	1.07	0.46	1.12
MEDPOL		Turkey	KARATAŞ	KARSW1-3	2015	0.6	0.86	0.84	1.35		0.9	1.36	0.81	1.74
MEDPOL		Turkey	MARMARİS	MARSW1-3	2015	0.3	0.88	1.20	1.36		0.4	1.40	1.15	1.69
MEDPOL		Turkey	SEYHAN	SEYSW3-3	2015	0.6	0.75	1.43	1.61		0.8	1.19	1.37	1.96
MEDPOL		Turkey	YUMURTAL	YUMSW1-3	2015	0.4	0.75	0.44	0.95		0.6	1.20	0.42	1.28
MEDPOL		Turkey	ANTALYA	ANBSW1	2015	0.6	0.92	0.80	1.31		0.7	1.45	0.76	1.71
MEDPOL		Turkey	GÖKSU NEHRİ	GRESW1	2015	0.5	0.72	0.35	0.93		0.7	1.14	0.34	1.28
MEDPOL		Turkey	SEYHAN	SEYSW1	2015	0.6	0.91	1.34	1.67		0.9	1.45	1.29	2.07
MEDPOL		Turkey	TIRTAR	TIRSW1	2015	0.5	1.01	1.22	1.57		0.7	1.60	1.16	1.98
IMAP	445	Turkey	Akkuyu	AKKUYU	2018	2.4	0.52	0.66	2.06		3.2	0.83	0.63	2.71
IMAP	445	Turkey	Akıncı Burnu	AKNSW1	2018	1.2	0.36	0.63	1.30		1.7	0.57	0.61	1.66
IMAP	445	Turkey	Alanya	ALBSW1	2018	0.5	0.08	0.45	0.57		0.6	0.12	0.43	0.67
IMAP	445	Turkey	Anamur	ANASW1	2018	2.0	0.38	0.81	1.85		2.7	0.60	0.77	2.37
IMAP	445	Turkey	Anamur	ANASWR	2018	2.5	0.53	1.11	2.37		3.3	0.83	1.07	3.03
IMAP	445	Turkey	Antalya Bay	ANBSW1	2018	1.0	0.46	0.88	1.36		1.4	0.74	0.84	1.70
IMAP	445	Turkey	Antalya Bay	ANBSWR	2018	0.9	0.45	0.73	1.22		1.3	0.72	0.70	1.54
IMAP	445	Turkey	Botaş	BTCSW1	2018	1.6	0.74	1.18	2.01		2.1	1.17	1.13	2.55
IMAP	445	Turkey	Ceyhan River	CEYSWR	2018	0.8	0.26	0.54	0.94		1.1	0.42	0.52	1.19
IMAP	445	Turkey	Dalaman River	DALSW1	2018	0.6	0.83	0.33	1.05		0.9	1.32	0.32	1.45
IMAP	445	Turkey	Dalaman River	DALSW2	2018	0.7	0.41	0.27	0.78		0.9	0.66	0.26	1.04
IMAP	445	Turkey	Dildare	DILSWR	2018	0.5	0.41	0.68	0.91		0.7	0.65	0.65	1.14
IMAP	445	Turkey		ECSW1	2018	0.8	0.52	0.49	1.07		1.1	0.83	0.47	1.41
IMAP	445	Turkey	Erdemli	ERDSWR	2018	1.2	0.42	0.87	1.41		1.6	0.66	0.83	1.77
IMAP	445	Turkey	Finike Bay	FIBSW1	2018	0.6	0.34	0.74	0.95		0.8	0.54	0.71	1.17
IMAP	445	Turkey	Göksu	GRESW1	2018	1.3	0.28	0.36	1.14		1.8	0.45	0.34	1.50
IMAP	445	Turkey	Göksu River	GRESW2	2018	3.4	0.34	0.56	2.50		4.7	0.53	0.54	3.31
IMAP	445	Turkey	İskenderun	ISKSW2	2018	0.8	0.87	0.43	1.23		1.1	1.38	0.42	1.69
IMAP	445	Turkey	İskenderun	ISKSW3	2018	0.7	0.41	0.60	1.01		1.0	0.65	0.58	1.29
IMAP	445	Turkey	İskenderun	ISKSWR	2018	1.3	0.43	1.03	1.60		1.8	0.68	0.98	1.99
IMAP	445	Turkey	Karataş	KARSW1	2018	0.8	0.24	0.64	0.97		1.1	0.39	0.61	1.20
IMAP	445	Turkey	Mersin Bay	MERSİN-DOGU-	2018	1.3	0.39	1.05	1.59		1.8	0.61	1.00	1.96
IMAP	445	Turkey	Mersin Bay	MERSWR	2018	1.6	0.48	0.95	1.73		2.1	0.76	0.91	2.19
IMAP	445	Turkey	Manavgat River	MRESW1	2018	1.0	0.10	0.28	0.78		1.3	0.16	0.27	1.00
IMAP	445	Turkey	Mersin Bay	MRSYB6	2018	1.4	0.42	1.24	1.77		1.9	0.67	1.19	2.18
IMAP	445	Turkey	Samandağ	SAMSWR	2018	1.8	0.37	0.38	1.47		2.5	0.58	0.36	1.96
IMAP	445	Turkey	Seyhan River	SEYSW1	2018	1.4	0.52	1.05	1.74		2.0	0.83	1.00	2.18
IMAP	445	Turkey	Seyhan River	SEYSW2	2018	1.5	0.36	1.13	1.74		2.1	0.57	1.08	2.15
IMAP	445	Turkey	Seyhan River	SEYSW3	2018	1.6	0.43	1.17	1.87		2.2	0.69	1.12	2.33
IMAP	445	Turkey	Taşucu	TASSW1	2018	3.0	0.33	0.63	2.27		4.0	0.52	0.60	2.98
IMAP	445	Turkey	Tırtar	TIRSW1	2018	1.6	0.61	1.02	1.88		2.2	0.96	0.98	2.40
IMAP	445	Turkey	İskenderun	YUM-REF	2018	1.2	0.47	0.73	1.37		1.6	0.74	0.70	1.75
IMAP	445	Turkey	Yumurtalık	YUMSW1	2018	0.8	0.20	0.51	0.88		1.1	0.32	0.49	1.10

Table A2.3. Results of the "traffic light" and the CHASE+ approaches to assess the environmental status of Σ16 PAHs in sediments in the Levantine Sea Basin. Traffic light approach: In green, values below BACs; in yellow, values between BAC and MED_EAC; in red values above the MED_EAC. Green and yellow stations are considered in GES, and red stations as non-GES. CHASE+ approach: Blue - NPAhigh (CS=0.0-0.5); Green- NPAgood (CS =0.5-2); Yellow- PAmoderate (CS =2-5.0); Brown - PApoor (CS =5.0-10.0) and Red - PAbad (CS > 10.0). Blue and green stations are considered in GES, yellow, brown and red stations are considered non-GES.

Source	IMAP file	Country	Station	Station	Year	TrafficLight MEDBAC	TrafficLight AELBAC		CR=Cmeas /MEDBAC	CR=Cmeas /AELBAC
IMAP_IS	152	Lebanon	Akkar-N. Lebanon	AKK-10	2019	7.9	7.9		0.19	0.25
IMAP_IS	152	Lebanon	Akkar-N. Lebanon	AKK-60	2019	17.4	17.4		0.42	0.54
IMAP_IS	152	Lebanon	Beirut	COSTA-10	2019	0.1	0.1		0.00	0.00
IMAP_IS	152	Lebanon	Beirut	COSTA-30	2019	17.2	17.2		0.42	0.54
IMAP_IS	152	Lebanon	Beirut	COSTA-60	2019	12.1	12.1		0.30	0.38
IMAP_IS	152	Lebanon	Damour	DAM-10	2019	0.4	0.4		0.01	0.01
IMAP_IS	152	Lebanon	Damour	DAM-60	2019	17.6	17.6		0.43	0.55
IMAP_IS	152	Lebanon	Beirut	DORA-10	2019	115.9	115.9		2.83	3.62
IMAP_IS	152	Lebanon	Beirut	DORA-100	2019	343.3	343.3		8.37	10.73
IMAP_IS	152	Lebanon	Beirut	DORA-30	2019	155.2	155.2		3.79	4.85
IMAP_IS	152	Lebanon	Byblos area	Nhr Ib	2019	1.2	1.2		0.03	0.04
IMAP_IS	152	Lebanon	Beirut	RAMLET-10	2019	1.6	1.6		0.04	0.05
IMAP_IS	152	Lebanon	Beirut	RAMLET-100	2019	347.6	347.6		8.48	10.86
IMAP_IS	152	Lebanon	Beirut	RAMLET-40	2019	395.9	395.9		9.66	12.37
IMAP_IS	152	Lebanon	Saida area	SDA-10	2019	335.4	335.4		8.18	10.48
IMAP_IS	152	Lebanon	Saida area	SDA-60	2019	10.0	10.0		0.25	0.31
IMAP_IS	152	Lebanon	Tripoli-N. Lebanon	TRI-10	2019	78.0	78.0		1.90	2.44
IMAP_IS	152	Lebanon	Tripoli-N. Lebanon	TRI-40	2019	12.6	12.6		0.31	0.39
IMAP_IS	152	Lebanon	Tripoli-N. Lebanon	TRI-60	2019	45.4	45.4		1.11	1.42
Lit-Astrahan et al. 2017		Israel		S11	2013	22.5	22.5		0.55	0.70
Lit-Astrahan et al. 2017		Israel		S12	2013	45.5	45.5		1.11	1.42
Lit-Astrahan et al. 2017		Israel		S13	2013	38.9	38.9		0.95	1.22
Lit-Astrahan et al. 2017		Israel		S14	2013	27.4	27.4		0.67	0.86
Lit-Astrahan et al. 2017		Israel		G1	2013	28.3	28.3		0.69	0.88
Lit-Astrahan et al. 2017		Israel		G2	2013	33	33		0.80	1.03
Lit-Astrahan et al. 2017		Israel		G3	2013	12	12		0.29	0.38
Lit-Astrahan et al. 2017		Israel		G4	2013	24.1	24.1		0.59	0.75
Lit-Astrahan et al. 2017		Israel		G5	2013	18.1	18.1		0.44	0.57
Lit-Astrahan et al. 2017		Israel		G6	2013	25.6	25.6		0.62	0.80
Lit-Astrahan et al. 2017		Israel		G7	2013	25.1	25.1		0.61	0.78
Lit-Astrahan et al. 2017		Israel		G8	2013	11	11		0.27	0.34
Lit-Astrahan et al. 2017		Israel		G9	2013	32.2	32.2		0.79	1.01
Lit-Astrahan et al. 2017		Israel		G10	2013	19.6	19.6		0.48	0.61
Lit-Astrahan et al. 2017		Israel		G11	2013	19.2	19.2		0.47	0.60
Lit-Astrahan et al. 2017		Israel		S21	2013	27.3	27.3		0.67	0.85
Lit-Astrahan et al. 2017		Israel		S22	2013	21.8	21.8		0.53	0.68
Lit-Astrahan et al. 2017		Israel		S23	2013	21.6	21.6		0.53	0.68
Lit-Astrahan et al. 2017		Israel		S24	2013	27.1	27.1		0.66	0.85
Lit-Astrahan et al. 2017		Israel		S25	2013	22.6	22.6		0.55	0.71
Lit-Astrahan et al. 2017		Israel		G12	2013	37.7	37.7		0.92	1.18
Lit-Astrahan et al. 2017		Israel		G13	2013	22.2	22.2		0.54	0.69
Lit-Astrahan et al. 2017		Israel		G14	2013	11.3	11.3		0.28	0.35
Lit-Astrahan et al. 2017		Israel		G15	2013	35.2	35.2		0.86	1.10
Lit-Astrahan et al. 2017		Israel		G16	2013	15.6	15.6		0.38	0.49
Lit-Astrahan et al. 2017		Israel		G17	2013	16.6	16.6		0.40	0.52
Lit-Astrahan et al. 2017		Israel		G31	2013	20.7	20.7		0.50	0.65
Lit-Astrahan et al. 2017		Israel		G18	2013	26.1	26.1		0.64	0.82
Lit-Astrahan et al. 2017		Israel		G18a	2013	25.9	25.9		0.63	0.81
Lit-Astrahan et al. 2017		Israel		G19	2013	19.2	19.2		0.47	0.60
Lit-Astrahan et al. 2017		Israel		G20	2013	17.2	17.2		0.42	0.54
Lit-Astrahan et al. 2017		Israel		G21	2013	13.4	13.4		0.33	0.42
Lit-Astrahan et al. 2017		Israel		G22	2013	16.8	16.8		0.41	0.53
Lit-Astrahan et al. 2017		Israel		S31	2013	23.8	23.8		0.58	0.74
Lit-Astrahan et al. 2017		Israel		S32	2013	33.5	33.5		0.82	1.05
Lit-Astrahan et al. 2017		Israel		S33	2013	33.6	33.6		0.82	1.05
Lit-Astrahan et al. 2017		Israel		S34	2013	43.7	43.7		1.07	1.37
Lit-Astrahan et al. 2017		Israel		S35	2013	41	41		1.00	1.28

Lit-Astrahan et al. 2017	Israel		G23	2013	31.5	31.5		0.77	0.98
Lit-Astrahan et al. 2017	Israel		G24	2013	38.1	38.1		0.93	1.19
Lit-Astrahan et al. 2017	Israel		G25	2013	17.6	17.6		0.43	0.55
Lit-Astrahan et al. 2017	Israel		G26	2013	19.7	19.7		0.48	0.62
Lit-Astrahan et al. 2017	Israel		G32	2013	17	17		0.41	0.53
Lit-Astrahan et al. 2017	Israel		S41	2013	28.2	28.2		0.69	0.88
Lit-Astrahan et al. 2017	Israel		S42	2013	147	147		3.59	4.59
Lit-Astrahan et al. 2017	Israel		S43	2013	188.1	188.1		4.59	5.88
Lit-Astrahan et al. 2017	Israel		S44	2013	68.6	68.6		1.67	2.14
Lit-Astrahan et al. 2017	Israel		S45	2013	96	96		2.34	3.00
Lit-Astrahan et al. 2017	Israel		G27	2013	84.5	84.5		2.06	2.64
Lit-Astrahan et al. 2017	Israel		G28	2013	21.1	21.1		0.51	0.66
Lit-Astrahan et al. 2017	Israel		G29	2013	19.8	19.8		0.48	0.62
Lit-Astrahan et al. 2017	Israel		G30	2013	15.2	15.2		0.37	0.48

Table A2.4. Results of the “traffic light” and the CHASE+ approaches to assess the environmental status of Σ7 PCBs in sediments in the Levantine Sea Basin. Traffic light approach: In green, values below BACs; in yellow, values between BAC and MED_EAC; in red values above the MED_EAC. Green and yellow stations are considered in GES, and red stations as non-GES. CHASE+ approach: Blue - NPAhigh (CS=0.0-0.5); Green- NPAgood (CS =0.5-2); Yellow- PAmoderate (CS =2-5.0); Brown - PApoor (CS =5.0-10.0) and Red - PAbad (CS > 10.0). Blue and green stations are considered in GES, yellow, brown and red stations are considered non-GES.

Source	File ID	Country	Area	Cruise	Year	Traffic light_ 3xMEDBC	CR=Cmea s/3xMED BC
IMAP	152	Lebanon	Akkar-North Lebanon	AKK-10	2019	0	0.0
IMAP	152	Lebanon	Akkar-North Lebanon	AKK-60	2019	2.8	2.3
IMAP	152	Lebanon	Beirut	COSTA-10	2019	0	0.0
IMAP	152	Lebanon	Beirut	COSTA-30	2019	0	0.0
IMAP	152	Lebanon	Beirut	COSTA-60	2019	0	0.0
IMAP	152	Lebanon	Damour	DAM-10	2019	0	0.0
IMAP	152	Lebanon	Damour	DAM-60	2019	0	0.0
IMAP	152	Lebanon	Beirut	DORA-10	2019	6.7	5.6
IMAP	152	Lebanon	Beirut	DORA-100	2019	13.9	11.6
IMAP	152	Lebanon	Beirut	DORA-30	2019	19.0	15.8
IMAP	152	Lebanon	Byblos area	Nhr Ib	2019	0.139	0.1
IMAP	152	Lebanon	Beirut	RAMLET-10	2019	0	0.0
IMAP	152	Lebanon	Beirut	RAMLET-100	2019	0	0.0
IMAP	152	Lebanon	Beirut	RAMLET-40	2019	4.1	3.4
IMAP	152	Lebanon	Saida area	SDA-10	2019	5.8	4.8
IMAP	152	Lebanon	Saida area	SDA-60	2019	0	0.0
IMAP	152	Lebanon	Tripoli-North Lebanon	TRI-10	2019	1.9	1.6
IMAP	152	Lebanon	Tripoli-North Lebanon	TRI-40	2019	3.0	2.5
IMAP	152	Lebanon	Tripoli-North Lebanon	TRI-60	2019	1.3	1.1
IMAP	445	Turkey	Akkuyu	AKKUYU	2018	0.22	0.2
IMAP	445	Turkey	Akıncı Burnu	AKNSW1	2018	0.15	0.1
IMAP	445	Turkey	Alanya	ALBSW1	2018	0.16	0.1
IMAP	445	Turkey	Anamur	ANASW1	2018	0.27	0.2
IMAP	445	Turkey	Anamur	ANASWR	2018	0.75	0.6
IMAP	445	Turkey	Antalya Bay	ANBSW1	2018	0.21	0.2
IMAP	445	Turkey	Antalya Bay	ANBSWR	2018	0.24	0.2
IMAP	445	Turkey	Botaş	BTCSW1	2018	0.78	0.7
IMAP	445	Turkey	Ceyhan River mouth	CEYSWR	2018	0.32	0.3
IMAP	445	Turkey	Dalaman River mouth	DALSW1	2018	0.11	0.1
IMAP	445	Turkey	Dalaman River mouth	DALSW2	2018	0.26	0.2
IMAP	445	Turkey	Dildare Burnu	DILSWR	2018	0.36	0.3
IMAP	445	Turkey		ECSW1	2018	0.27	0.2
IMAP	445	Turkey	Erdemli	ERDSWR	2018	0.19	0.2
IMAP	445	Turkey	Finike Bay	FIBSW1	2018	0.21	0.2
IMAP	445	Turkey	Göksu	GRESW1	2018	0.69	0.6
IMAP	445	Turkey	Göksu River mouth	GRESW2	2018	0.22	0.2
IMAP	445	Turkey	İskenderun Bay	ISKSW2	2018	0.23	0.2
IMAP	445	Turkey	İskenderun Bay	ISKSW3	2018	0.20	0.2
IMAP	445	Turkey	İskenderun Bay	ISKSWR	2018	0.19	0.2
IMAP	445	Turkey	Karataş	KARSW1	2018	0.30	0.3

IMAP	445	Turkey	Mersin Bay	MERSİN-DOGU-REF	2018	0.28	0.2
IMAP	445	Turkey	Mersin Bay	MERSWR	2018	1.27	1.1
IMAP	445	Turkey	Manavgat River mouth	MRESW1	2018	0.17	0.1
IMAP	445	Turkey	Mersin Bay	MRSYB6	2018	0.21	0.2
IMAP	445	Turkey	Samandağ	SAMSWR	2018	0.12	0.1
IMAP	445	Turkey	Seyhan River mouth	SEYSW1	2018	0.33	0.3
IMAP	445	Turkey	Seyhan River mouth	SEYSW2	2018	0.22	0.2
IMAP	445	Turkey	Seyhan River mouth	SEYSW3	2018	0.31	0.3
IMAP	445	Turkey	Taşucu	TASSW1	2018	0.17	0.1
IMAP	445	Turkey	Tırtar	TIRSW1	2018	0.23	0.2
IMAP	445	Turkey	İskenderun Bay	YUM-REF	2018	0.39	0.3
IMAP	445	Turkey	Yumurtalık	YUMSW1	2018	0.14	0.1

Table A2.5. Results of the "traffic light" approach to assess the environmental status of TM in *M. barbatus* in the Levantine Sea Basin. In green, values below BACs; in yellow, values between BAC and MED_EAC; in red values above the MED_EAC. Green and yellow stations are considered in GES, and red stations as non-GES.

Source	IMAP file	Country	Station	Year	Cd MEDBAC	Hg MEDBAC	Pb MEDBAC		Cd AELBAC	Hg AELBAC	Pb AELBAC
IMAP_IS	152	Lebanon	MB2 BEY	2019	0.081	2.305	4.850		0.081	2.305	4.850
IMAP_IS	152	Lebanon	MB4 BEY	2019	0.151	4.122	7.134		0.151	4.122	7.134
IMAP_IS	152	Lebanon	MB5 BEY	2019	0.198	2.900	3.363		0.198	2.900	3.363
IMAP_IS	152	Lebanon	MB7 BEY	2019	0.220	2.078	2.071		0.220	2.078	2.071
IMAP_IS	152	Lebanon	MB8 BEY	2019	0.162	4.397	13.475		0.162	4.397	13.475
IMAP_IS	152	Lebanon	MB9 BEY	2019	0.087	2.753	15.233		0.087	2.753	15.233
IMAP_IS	152	Lebanon	MB10 BEY	2019	0.133	4.138	2.744		0.133	4.138	2.744
IMAP_IS	152	Lebanon	MB5 TRIP	2019	0.482	12.309	15.686		0.482	12.309	15.686
IMAP_IS	152	Lebanon	MB1 TYRE	2019	0.067	9.222	0.441		0.067	9.222	0.441
IMAP_IS	152	Lebanon	MB4 TYRE	2019	0.597	15.719	2.817		0.597	15.719	2.817
IMAP_IS	152	Lebanon	MB6 TYRE	2019	0.788	86.967	9.431		0.788	86.967	9.431
IMAP_IS	152	Lebanon	MB7 TYRE	2019	0.190	6.879	0.571		0.190	6.879	0.571
IMAP_IS	152	Lebanon	MS1 TYRE	2019	0.544	13.266	5.299		0.544	13.266	5.299
IMAP_IS	152	Lebanon	MS2 TYRE	2019	0.483	33.645	7.311		0.483	33.645	7.311
IMAP_IS	410	Israel	TRAWL C	2019	1.82	121			1.82	121	
IMAP_IS	410	Israel	TRAWL C	2019	1.50	65.8			1.50	65.8	
IMAP_IS	410	Israel	TRAWL C	2019	2.48	67.8			2.48	67.8	
IMAP_IS	410	Israel	TRAWL C	2019	2.23	62.3			2.23	62.3	
IMAP_IS	410	Israel	TRAWL C	2019	2.50	79.3			2.50	79.3	
IMAP_IS	410	Israel	TRAWL C	2019	2.07	58.5			2.07	58.5	
IMAP_IS	410	Israel	TRAWL C	2019	2.93	72.1			2.93	72.1	
IMAP_IS	351	Israel	TRAWL C	2015		22.0				22.0	
IMAP_IS	351	Israel	TRAWL C	2015		13.2				13.2	
IMAP_IS	351	Israel	TRAWL C	2015		12.9				12.9	
IMAP_IS	351	Israel	TRAWL C	2015		19.5				19.5	
IMAP_IS	351	Israel	TRAWL C	2015		11.0				11.0	
IMAP_IS	351	Israel	TRAWL C	2015		12.8				12.8	
IMAP_IS	351	Israel	TRAWL C	2015		17.9				17.9	
IMAP_IS	351	Israel	TRAWL C	2015		20.1				20.1	
IMAP_IS	351	Israel	TRAWL C	2015		19.4				19.4	
IMAP_IS	351	Israel	TRAWL C	2015		13.7				13.7	
IMAP_IS	351	Israel	TRAWL C	2015		19.8				19.8	
IMAP_IS	351	Israel	TRAWL N	2015		36.9				36.9	
IMAP_IS	351	Israel	TRAWL N	2015		45.9				45.9	
IMAP_IS	351	Israel	TRAWL N	2015		31.2				31.2	
IMAP_IS	351	Israel	TRAWL N	2015		16.5				16.5	
IMAP_IS	351	Israel	TRAWL N	2015		57.6				57.6	
IMAP_IS	351	Israel	TRAWL N	2015		34.2				34.2	
IMAP_IS	351	Israel	TRAWL N	2015		74.9				74.9	

IMAP_IS	351	Israel	TRAWLN	2015		67.0				67.0		
IMAP_IS	351	Israel	TRAWLN	2015		33.7				33.7		
IMAP_IS	351	Israel	TRAWLN	2015		46.5				46.5		
IMAP_IS	351	Israel	TRAWLS	2015		26.8				26.8		
IMAP_IS	351	Israel	TRAWLS	2015		45.3				45.3		
IMAP_IS	351	Israel	TRAWLS	2015		27.7				27.7		
IMAP_IS	351	Israel	TRAWLS	2015		15.1				15.1		
IMAP_IS	351	Israel	TRAWLS	2015		23.3				23.3		
IMAP_IS	351	Israel	TRAWLS	2015		40.7				40.7		
IMAP_IS	351	Israel	TRAWLS	2015		42.6				42.6		
IMAP_IS	71	Israel	TRAWLS	2018	0.77	97.8			0.77	97.8		
IMAP_IS	71	Israel	TRAWLS	2018	0.86	48.0			0.86	48.0		
IMAP_IS	71	Israel	TRAWLS	2018	0.89	40.7			0.89	40.7		
IMAP_IS	71	Israel	TRAWLS	2018	1.89	50.0			1.89	50.0		
IMAP_IS	71	Israel	TRAWLS	2018	2.05	59.7			2.05	59.7		
IMAP_IS	71	Israel	TRAWLS	2018	1.38	72.9			1.38	72.9		
IMAP_IS	71	Israel	TRAWLS	2018	1.48	45.3			1.48	45.3		
IMAP_IS	71	Israel	TRAWLS	2018	0.99	53.2			0.99	53.2		
IMAP_IS	71	Israel	TRAWLS	2018	1.47	49.3			1.47	49.3		
IMAP_IS	71	Israel	TRAWLS	2018	0.84	40.9			0.84	40.9		
IMAP_IS	71	Israel	TRAWLS	2018	1.24	45.9			1.24	45.9		
IMAP_IS	71	Israel	TRAWLS	2018	1.51	55.3			1.51	55.3		
IMAP_IS	71	Israel	TRAWLS	2018	1.17	40.6			1.17	40.6		
IMAP_IS	323	Turkey	Tırtar / Mersin 1	2015	3.92	29.18	8.38		3.92	29.18	8.38	
IMAP_IS	323	Turkey	Tırtar / Mersin 2	2015	3.11	32.02	10.07		3.11	32.02	10.07	
IMAP_IS	323	Turkey	Tırtar / Mersin 3	2015	1.75	29.17	5.75		1.75	29.17	5.75	
IMAP_IS	323	Turkey	Tırtar / Mersin 4	2015	1.43	26.10	6.24		1.43	26.10	6.24	
IMAP_IS	323	Turkey	Tırtar / Mersin 5	2015	6.00	32.97	7.86		6.00	32.97	7.86	
IMAP_IS	323	Turkey	Seyhan/ Adana 1	2015	5.27	35.57	15.30		5.27	35.57	15.30	
IMAP_IS	323	Turkey	Seyhan / Adana 2	2015	4.30	30.54	12.23		4.30	30.54	12.23	
IMAP_IS	323	Turkey	Seyhan / Adana 3	2015	4.68	36.56	21.56		4.68	36.56	21.56	
IMAP_IS	323	Turkey	Seyhan / Adana 4	2015	3.99	32.87	14.48		3.99	32.87	14.48	
IMAP_IS	323	Turkey	Seyhan / Adana 5	2015	5.61	30.81	13.20		5.61	30.81	13.20	
IMAP_IS	323	Turkey	Anamur / Mersin 1	2015	8.61	192.36	27.99		8.61	192.36	27.99	
IMAP_IS	323	Turkey	Anamur / Mersin 2	2015	4.60	172.48	27.90		4.60	172.48	27.90	
IMAP_IS	323	Turkey	Anamur / Mersin 3	2015	6.49	155.33	26.13		6.49	155.33	26.13	
IMAP_IS	323	Turkey	Anamur / Mersin 4	2015	4.99	126.86	24.63		4.99	126.86	24.63	
IMAP_IS	323	Turkey	Anamur / Mersin 5	2015	6.22	151.00	19.87		6.22	151.00	19.87	
IMAP_IS	323	Turkey	Göksu / Mersin 1	2015	2.52	87.06	15.30		2.52	87.06	15.30	
IMAP_IS	323	Turkey	Göksu / Mersin 2	2015	1.49	73.97	11.69		1.49	73.97	11.69	
IMAP_IS	323	Turkey	Göksu / Mersin 3	2015	1.61	89.09	18.92		1.61	89.09	18.92	
IMAP_IS	323	Turkey	Göksu / Mersin 4	2015	3.48	77.79	17.67		3.48	77.79	17.67	
IMAP_IS	323	Turkey	Göksu / Mersin 5	2015	3.96	86.94	14.68		3.96	86.94	14.68	
IMAP_IS	323	Turkey	Karataş / Adana 1	2015	3.59	32.36	19.44		3.59	32.36	19.44	
IMAP_IS	323	Turkey	Karataş / Adana 2	2015	2.41	34.97	16.43		2.41	34.97	16.43	
IMAP_IS	323	Turkey	Karataş / Adana 3	2015	3.09	34.03	22.17		3.09	34.03	22.17	
IMAP_IS	323	Turkey	Karataş / Adana 4	2015	5.88	31.96	23.10		5.88	31.96	23.10	
IMAP_IS	323	Turkey	Karataş / Adana 5	2015	4.15	38.96	27.47		4.15	38.96	27.47	

Table A2.6. Results of the CHASE+ approach to assess the environmental status of TM in *M. barbatus* in the Levantine Sea Basin. Blue - NPAhigh (CS=0.0-0.5); Green- NPAgood (CS =0.5-1.5); Yellow-PAmoderate (CS =1.5-5.0); Brown - PApoor (CS =5.0-10.0) and Red - PAbad (CS > 10.0). Blue and green stations are considered in GES, yellow, brown and red stations are considered non-GES.

Source	IMAP file	Country	Station	Year	Cd_CR=C measured /MedBAC	Hg_CR=C measured /MedBAC	Pb_CR=C measured /MedBAC	CS with MED_BACs		_Cd_CR=C measured /AEL_BAC	Hg_CR=C measured /AEL_BAC	Pb_CR=C measured /AEL_BAC	CS with AEL_BACs
IMAP_IS	152	Lebanon	MB2 BEY	2019	0.010	0.028	0.13	0.10		0.011	0.034	0.18	0.13
IMAP_IS	152	Lebanon	MB4 BEY	2019	0.019	0.051	0.19	0.15		0.021	0.061	0.26	0.20
IMAP_IS	152	Lebanon	MB5 BEY	2019	0.025	0.036	0.09	0.09		0.027	0.043	0.12	0.11
IMAP_IS	152	Lebanon	MB7 BEY	2019	0.028	0.026	0.06	0.06		0.031	0.031	0.08	0.08
IMAP_IS	152	Lebanon	MB8 BEY	2019	0.021	0.054	0.37	0.26		0.022	0.065	0.50	0.34
IMAP_IS	152	Lebanon	MB9 BEY	2019	0.011	0.034	0.42	0.27		0.012	0.041	0.56	0.36
IMAP_IS	152	Lebanon	MB10 BEY	2019	0.017	0.051	0.07	0.08		0.019	0.061	0.10	0.10
IMAP_IS	152	Lebanon	MB5 TRIP	2019	0.062	0.152	0.43	0.37		0.067	0.183	0.58	0.48
IMAP_IS	152	Lebanon	MB1 TYRE	2019	0.009	0.114	0.01	0.08		0.009	0.137	0.02	0.09
IMAP_IS	152	Lebanon	MB4 TYRE	2019	0.076	0.194	0.08	0.20		0.083	0.233	0.10	0.24
IMAP_IS	152	Lebanon	MB6 TYRE	2019	0.101	1.071	0.26	0.83		0.109	1.290	0.35	1.01
IMAP_IS	152	Lebanon	MB7 TYRE	2019	0.024	0.085	0.02	0.07		0.026	0.102	0.02	0.09
IMAP_IS	152	Lebanon	MS1 TYRE	2019	0.070	0.163	0.14	0.22		0.076	0.197	0.20	0.27
IMAP_IS	152	Lebanon	MS2 TYRE	2019	0.062	0.414	0.20	0.39		0.067	0.499	0.27	0.48
IMAP_IS	410	Israel	TRAWL C	2019	0.234	1.487		1.22		0.253	1.791		1.45
IMAP_IS	410	Israel	TRAWL C	2019	0.193	0.810		0.71		0.209	0.976		0.84
IMAP_IS	410	Israel	TRAWL C	2019	0.318	0.835		0.82		0.345	1.006		0.95
IMAP_IS	410	Israel	TRAWL C	2019	0.286	0.767		0.74		0.310	0.924		0.87
IMAP_IS	410	Israel	TRAWL C	2019	0.320	0.977		0.92		0.347	1.177		1.08
IMAP_IS	410	Israel	TRAWL C	2019	0.265	0.720		0.70		0.287	0.868		0.82
IMAP_IS	410	Israel	TRAWL C	2019	0.376	0.888		0.89		0.407	1.070		1.04
IMAP_IS	351	Israel	TRAWL C	2015		0.270		0.270			0.326		0.326
IMAP_IS	351	Israel	TRAWL C	2015		0.162		0.162			0.195		0.195
IMAP_IS	351	Israel	TRAWL C	2015		0.159		0.159			0.192		0.192
IMAP_IS	351	Israel	TRAWL C	2015		0.240		0.240			0.289		0.289
IMAP_IS	351	Israel	TRAWL C	2015		0.136		0.136			0.164		0.164
IMAP_IS	351	Israel	TRAWL C	2015		0.157		0.157			0.189		0.189
IMAP_IS	351	Israel	TRAWL C	2015		0.221		0.221			0.266		0.266
IMAP_IS	351	Israel	TRAWL C	2015		0.247		0.247			0.298		0.298
IMAP_IS	351	Israel	TRAWL C	2015		0.239		0.239			0.288		0.288
IMAP_IS	351	Israel	TRAWL C	2015		0.169		0.169			0.203		0.203
IMAP_IS	351	Israel	TRAWL C	2015		0.244		0.244			0.294		0.294
IMAP_IS	351	Israel	TRAWL N	2015		0.454		0.454			0.547		0.547
IMAP_IS	351	Israel	TRAWL N	2015		0.565		0.565			0.681		0.681
IMAP_IS	351	Israel	TRAWL N	2015		0.384		0.384			0.463		0.463
IMAP_IS	351	Israel	TRAWL N	2015		0.203		0.203			0.245		0.245
IMAP_IS	351	Israel	TRAWL N	2015		0.710		0.710			0.855		0.855
IMAP_IS	351	Israel	TRAWL N	2015		0.421		0.421			0.507		0.507
IMAP_IS	351	Israel	TRAWL N	2015		0.922		0.922			1.111		1.111
IMAP_IS	351	Israel	TRAWL N	2015		0.825		0.825			0.995		0.995
IMAP_IS	351	Israel	TRAWL N	2015		0.415		0.415			0.500		0.500
IMAP_IS	351	Israel	TRAWL N	2015		0.572		0.572			0.690		0.690
IMAP_IS	351	Israel	TRAWL S	2015		0.330		0.330			0.398		0.398
IMAP_IS	351	Israel	TRAWL S	2015		0.558		0.558			0.672		0.672
IMAP_IS	351	Israel	TRAWL S	2015		0.341		0.341			0.411		0.411
IMAP_IS	351	Israel	TRAWL S	2015		0.186		0.186			0.224		0.224
IMAP_IS	351	Israel	TRAWL S	2015		0.288		0.288			0.346		0.346
IMAP_IS	351	Israel	TRAWL S	2015		0.500		0.501			0.603		0.603
IMAP_IS	351	Israel	TRAWL S	2015		0.525		0.525			0.632		0.632
IMAP_IS	71	Israel	TRAWL S	2018	0.099	1.204		0.92		0.107	1.451		1.10
IMAP_IS	71	Israel	TRAWL S	2018	0.110	0.591		0.50		0.119	0.713		0.59
IMAP_IS	71	Israel	TRAWL S	2018	0.114	0.501		0.43		0.124	0.604		0.51

IMAP_IS	71	Israel	TRAWL S	2018	0.243	0.616		0.61		0.263	0.742		0.71
IMAP_IS	71	Israel	TRAWL S	2018	0.263	0.735		0.71		0.285	0.885		0.83
IMAP_IS	71	Israel	TRAWL S	2018	0.177	0.898		0.76		0.192	1.082		0.90
IMAP_IS	71	Israel	TRAWL S	2018	0.190	0.558		0.53		0.206	0.672		0.62
IMAP_IS	71	Israel	TRAWL S	2018	0.127	0.655		0.55		0.138	0.789		0.66
IMAP_IS	71	Israel	TRAWL S	2018	0.189	0.608		0.56		0.205	0.732		0.66
IMAP_IS	71	Israel	TRAWL S	2018	0.107	0.504		0.43		0.116	0.607		0.51
IMAP_IS	71	Israel	TRAWL S	2018	0.159	0.565		0.51		0.172	0.681		0.60
IMAP_IS	71	Israel	TRAWL S	2018	0.194	0.681		0.62		0.210	0.820		0.73
IMAP_IS	71	Israel	TRAWL S	2018	0.151	0.500		0.46		0.163	0.602		0.54
IMAP_IS	323	Turkey	Tırtar / Mersin 1	2015	0.503	0.359	0.23	0.63		0.545	0.433	0.31	0.74
IMAP_IS	323	Turkey	Tırtar / Mersin 2	2015	0.399	0.394	0.28	0.62		0.432	0.475	0.37	0.74
IMAP_IS	323	Turkey	Tırtar / Mersin 3	2015	0.224	0.359	0.16	0.43		0.242	0.433	0.21	0.51
IMAP_IS	323	Turkey	Tırtar / Mersin 4	2015	0.183	0.321	0.17	0.39		0.198	0.387	0.23	0.47
IMAP_IS	323	Turkey	Tırtar / Mersin 5	2015	0.770	0.406	0.21	0.80		0.834	0.489	0.29	0.93
IMAP_IS	323	Turkey	Seyhan/ Adana 1	2015	0.675	0.438	0.42	0.88		0.732	0.528	0.57	1.05
IMAP_IS	323	Turkey	Seyhan / Adana 2	2015	0.552	0.376	0.33	0.73		0.598	0.453	0.45	0.87
IMAP_IS	323	Turkey	Seyhan / Adana 3	2015	0.600	0.450	0.59	0.95		0.650	0.542	0.80	1.15
IMAP_IS	323	Turkey	Seyhan / Adana 4	2015	0.511	0.405	0.40	0.76		0.554	0.488	0.54	0.91
IMAP_IS	323	Turkey	Seyhan / Adana 5	2015	0.719	0.379	0.36	0.84		0.779	0.457	0.49	1.00
IMAP_IS	323	Turkey	Anamur / Mersin 1	2015	1.104	2.369	0.76	2.45		1.195	2.854	1.04	2.94
IMAP_IS	323	Turkey	Anamur / Mersin 2	2015	0.590	2.124	0.76	2.01		0.639	2.559	1.03	2.44
IMAP_IS	323	Turkey	Anamur / Mersin 3	2015	0.832	1.913	0.71	2.00		0.901	2.305	0.97	2.41
IMAP_IS	323	Turkey	Anamur / Mersin 4	2015	0.640	1.562	0.67	1.66		0.694	1.882	0.91	2.01
IMAP_IS	323	Turkey	Anamur / Mersin 5	2015	0.797	1.860	0.54	1.85		0.864	2.240	0.74	2.22
IMAP_IS	323	Turkey	Göksu / Mersin 1	2015	0.323	1.072	0.42	1.05		0.350	1.292	0.57	1.28
IMAP_IS	323	Turkey	Göksu / Mersin 2	2015	0.191	0.911	0.32	0.82		0.207	1.097	0.43	1.003
IMAP_IS	323	Turkey	Göksu / Mersin 3	2015	0.207	1.097	0.52	1.05		0.224	1.322	0.70	1.30
IMAP_IS	323	Turkey	Göksu / Mersin 4	2015	0.447	0.958	0.48	1.09		0.484	1.154	0.65	1.32
IMAP_IS	323	Turkey	Göksu / Mersin 5	2015	0.508	1.071	0.40	1.14		0.550	1.290	0.54	1.38
IMAP_IS	323	Turkey	Karataş / Adana 1	2015	0.461	0.398	0.53	0.80		0.499	0.480	0.72	0.98
IMAP_IS	323	Turkey	Karataş / Adana 2	2015	0.309	0.431	0.45	0.69		0.335	0.519	0.61	0.84
IMAP_IS	323	Turkey	Karataş / Adana 3	2015	0.396	0.419	0.61	0.82		0.429	0.505	0.82	1.01
IMAP_IS	323	Turkey	Karataş / Adana 4	2015	0.754	0.394	0.63	1.03		0.816	0.474	0.86	1.24
IMAP_IS	323	Turkey	Karataş / Adana 5	2015	0.532	0.480	0.75	1.02		0.577	0.578	1.02	1.25

Annex III

Maps of selected Traffic light and CHASE+ assessment results for IMAP CI-17 in the Levantine Sea Basin

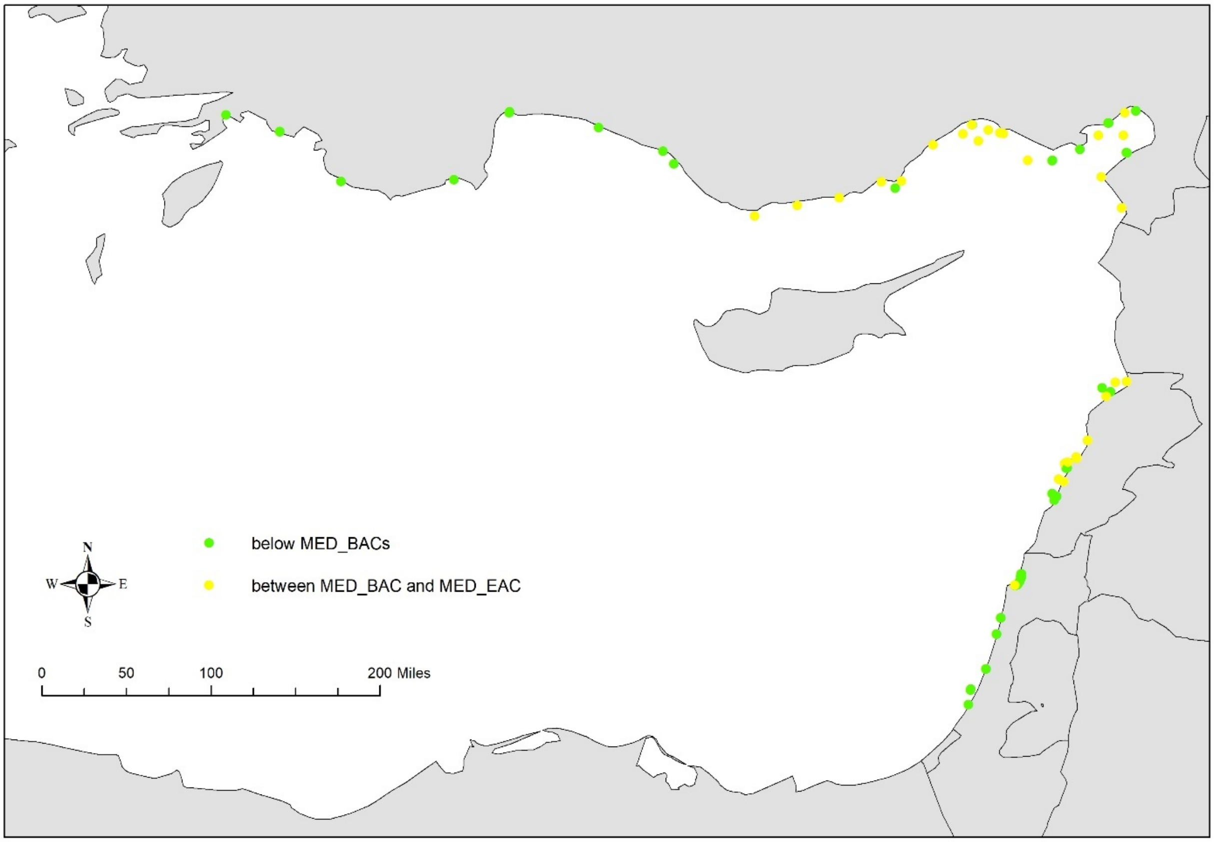

Figure 1. Results of the “traffic light” approach to assess the environmental status of Cd in sediments in the Levantine Sea Basin; stations marked in green: values below MED_BACs; stations marked in yellow: values between MED_BAC and MED_EAC; stations marked in red: values above the MED_EAC; stations marked in green and yellow are considered in GES, and stations in red are considered in non-GES.

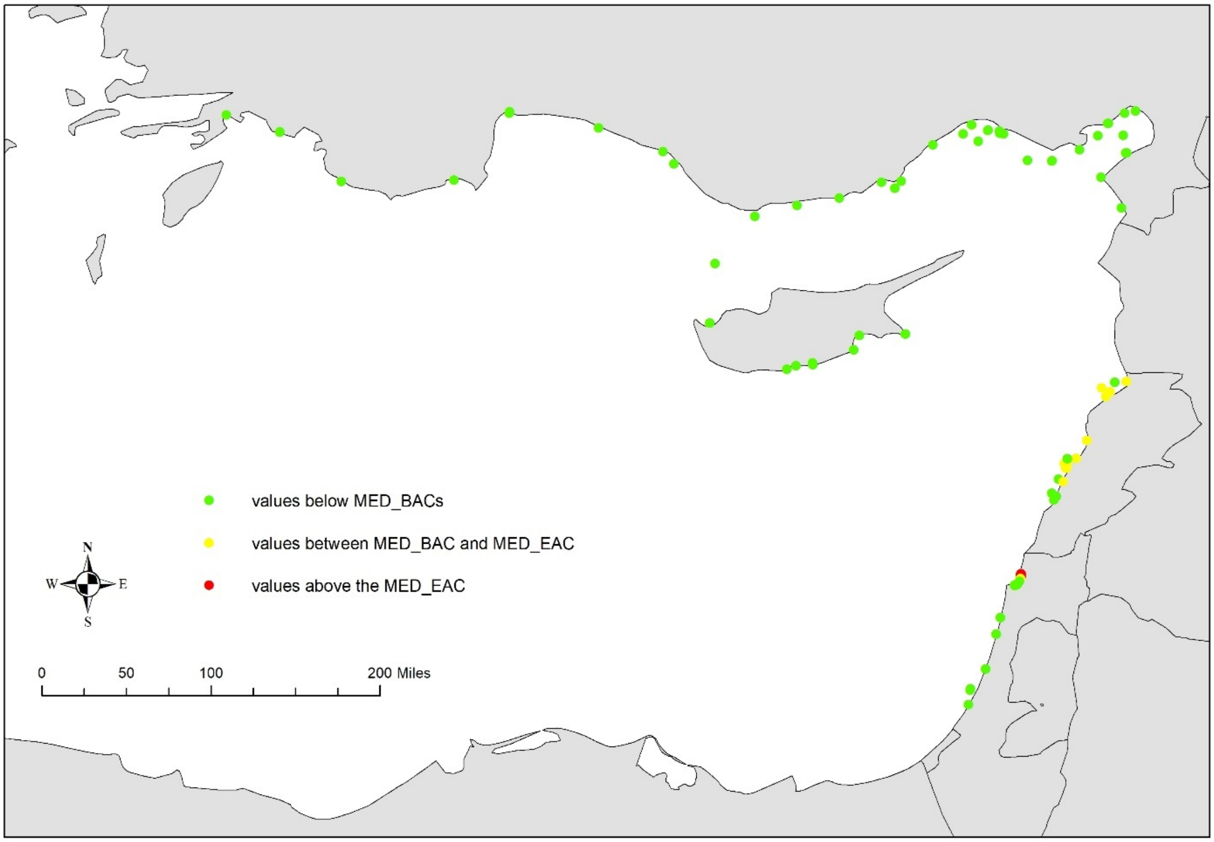

Figure 2. Results of the "traffic light" approach to assess the environmental status of Hg in sediments in the Levantine Sea Basin; stations marked in green indicate the values below MED_BACs; stations marked in yellow indicate the values between MED_BAC and MED_EAC; stations marked in red indicate the values above the MED_EAC; stations marked in green and yellow are considered in GES, and stations in red are considered in non-GES.

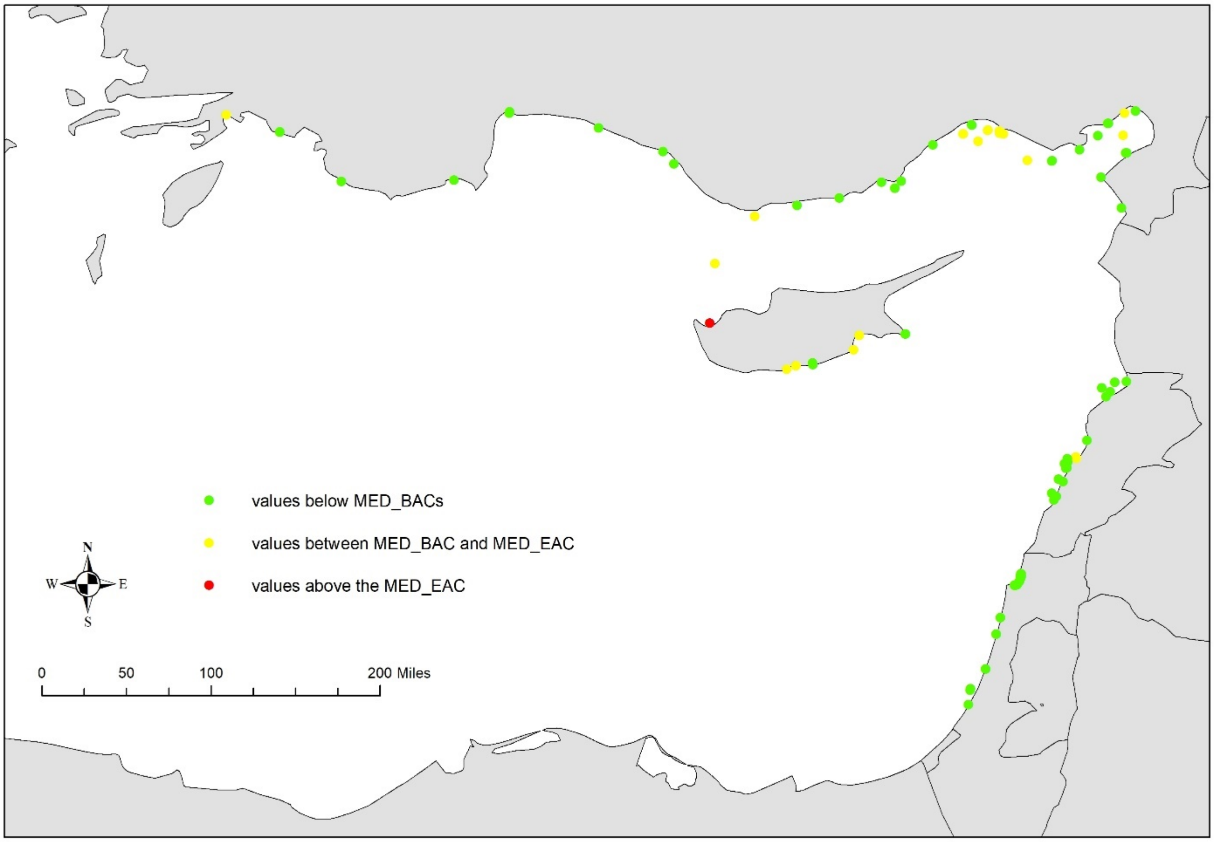

Figure 3. Results of the “traffic light” approach to assess the environmental status of Pb in sediments in the Levantine Sea Basin; stations marked in green indicate the values below MED_BACs; stations marked in yellow indicate the values between MED_BAC and MED_EAC; stations marked in red indicate the values above the MED_EAC; stations marked in green and yellow are considered in GES, and stations in red are considered in non-GES.

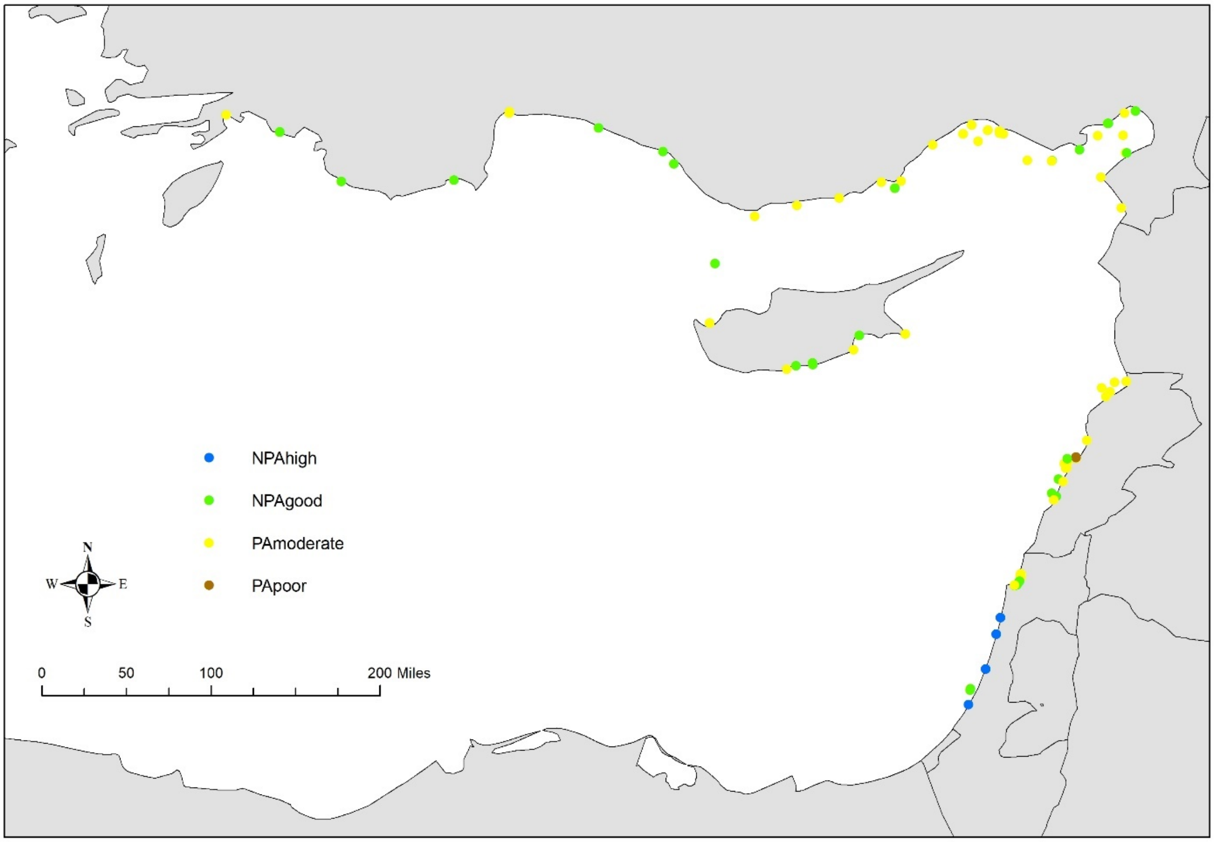

Figure 4. Results of the CHASE+ approach to assess the environmental status of trace metals (Cd, Hg, Pb) in sediments in the Levantine Sea Basin, using MED_BACs; stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.5); stations in yellow- PAmoderate (CS =1.5-5.0); stations in brown - PApoor (CS =5.0-10.0) and stations in red - PAbad (CS > 10.0); stations in blue and green are considered in GES, and stations in yellow, brown and red are considered in non-GES.

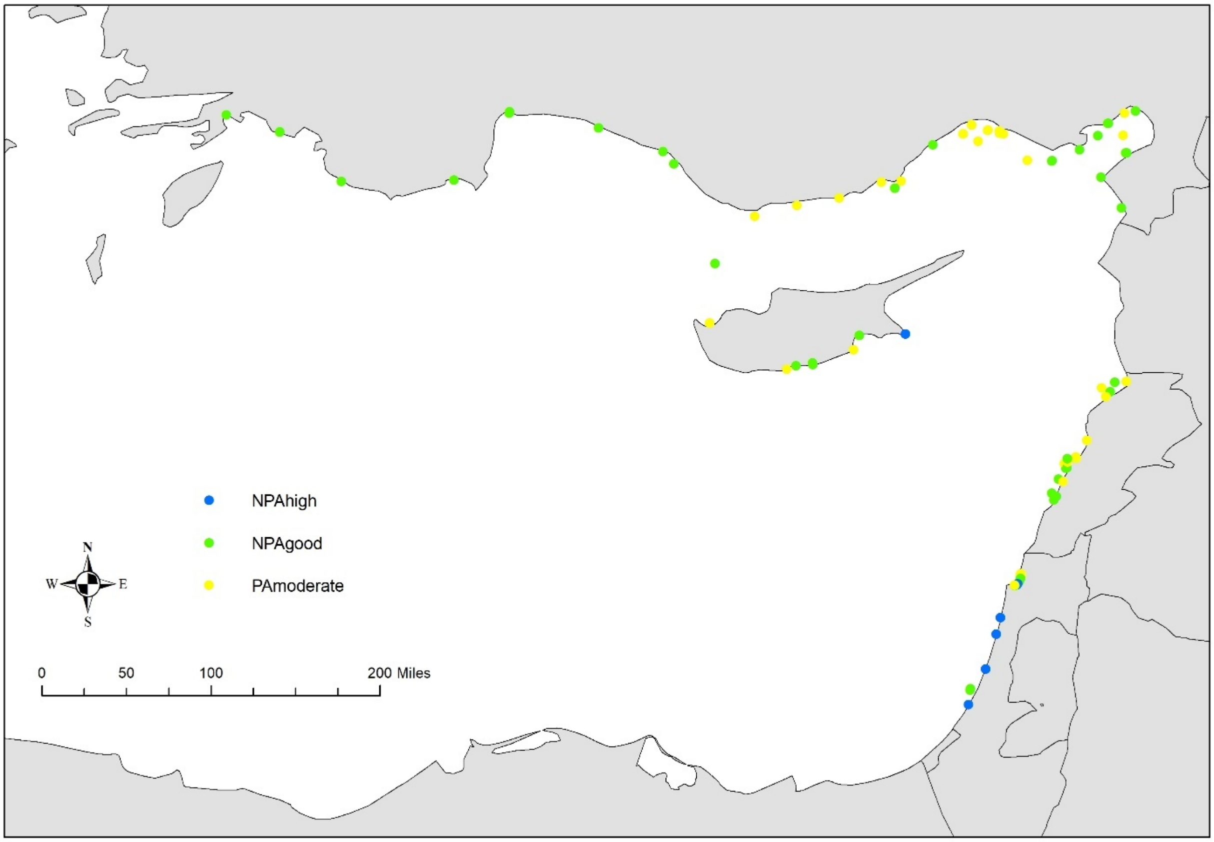

Figure 5. Results of the CHASE+ approach to assess the environmental status of trace metals (Cd, Hg, Pb) in sediments in the Levantine Sea Basin, using AEL_BACs; stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.5); stations in yellow- PAmoderate (CS =1.5-5.0); stations in brown - PApoor (CS =5.0-10.0) and stations in red - PAbad (CS > 10.0); stations in blue and green are considered in GES, and stations in yellow, brown and red are considered in non-GES

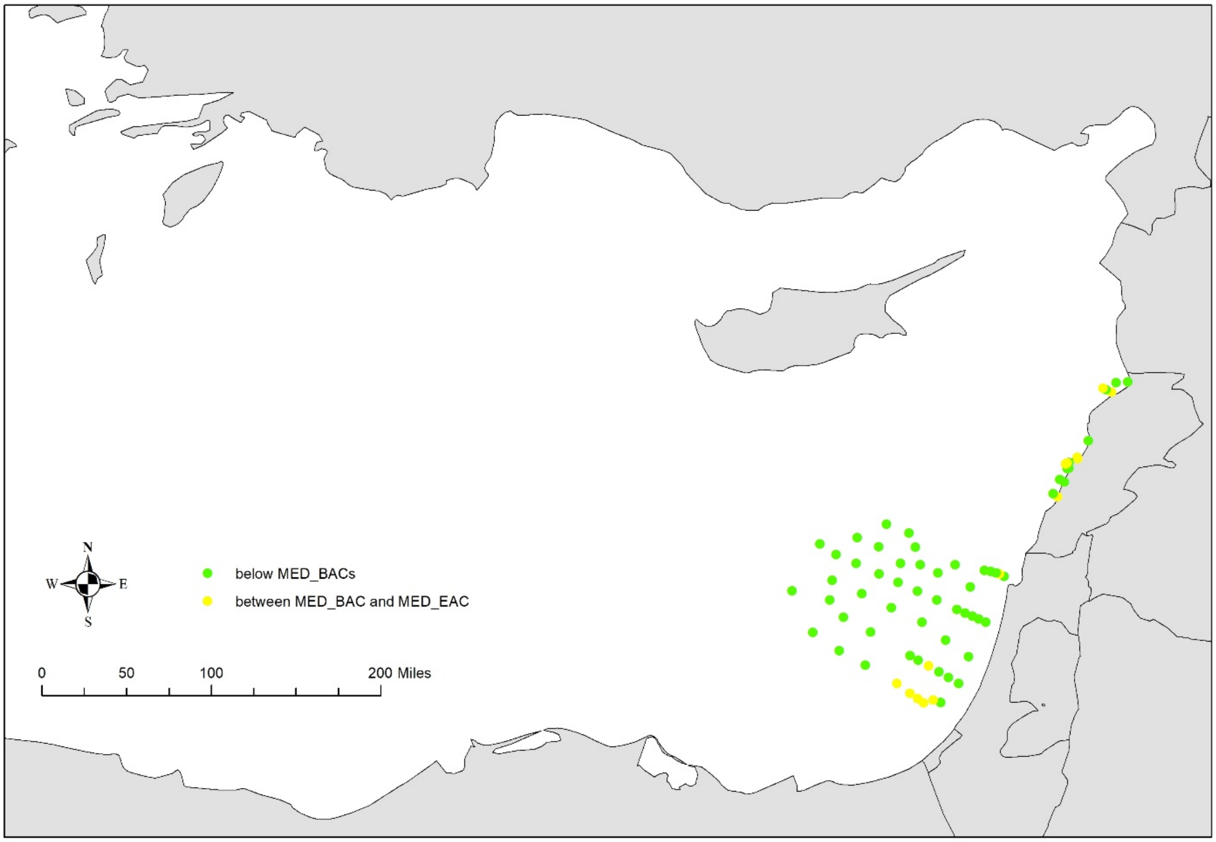

Figure 6. Results of the “traffic light” approach to assess the environmental status of Σ16 PAHs in sediments in the Levantine Sea Basin; stations in green correspond to the values below MED_BACs; stations in yellow correspond to the values between MED_BAC and MED_EAC; stations in red correspond to the values above the MED_EAC; stations in green and yellow are considered in GES, and stations in red in non-GES

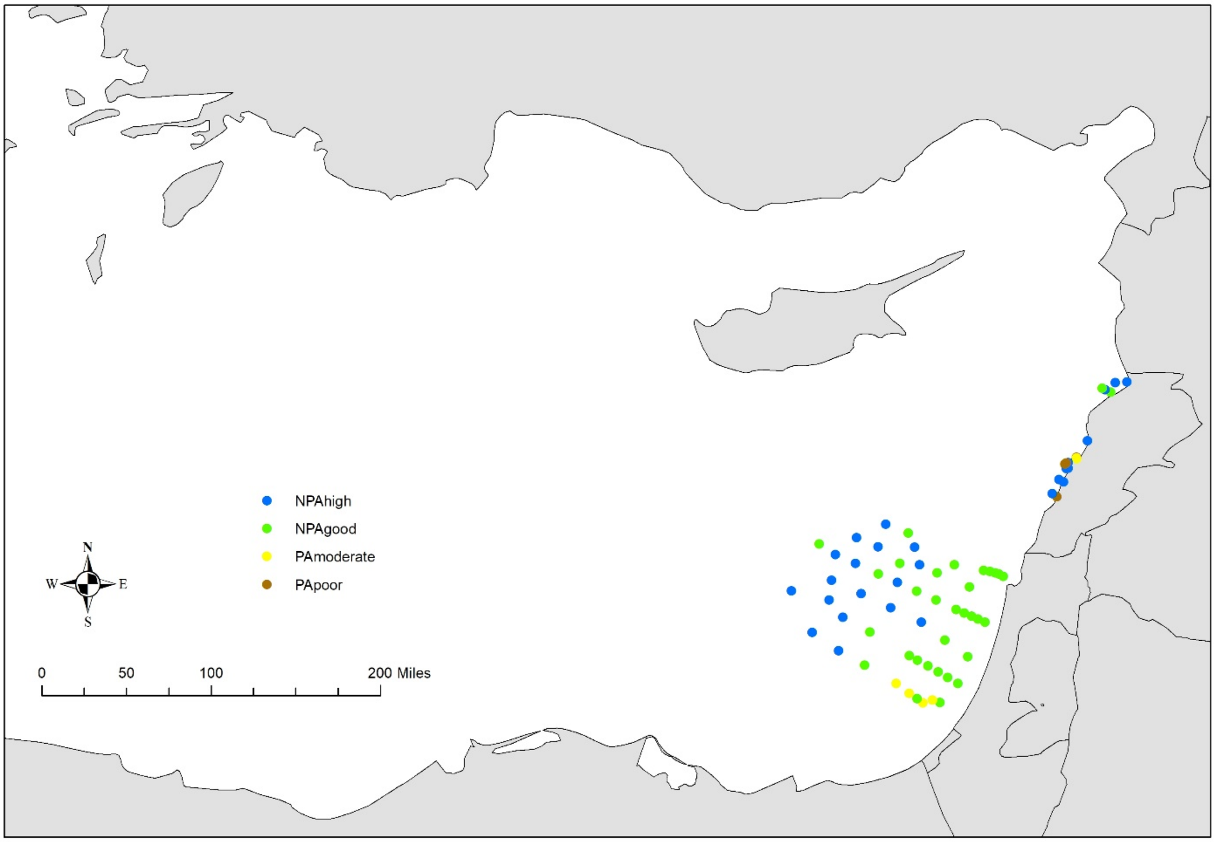

Figure 7. Results of the CHASE+ approach to assess the environmental status of Σ16 PAHs in sediments in the Levantine Sea Basin, using MED_BACs; stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.5); stations in yellow- PAmoderate (CS =1.5-5.0); stations in brown - PApoor (CS =5.0-10.0) and stations in red - PAbad (CS > 10.0); stations in green and yellow are considered in GES, stations in yellow, brown and red are considered in non-GES.

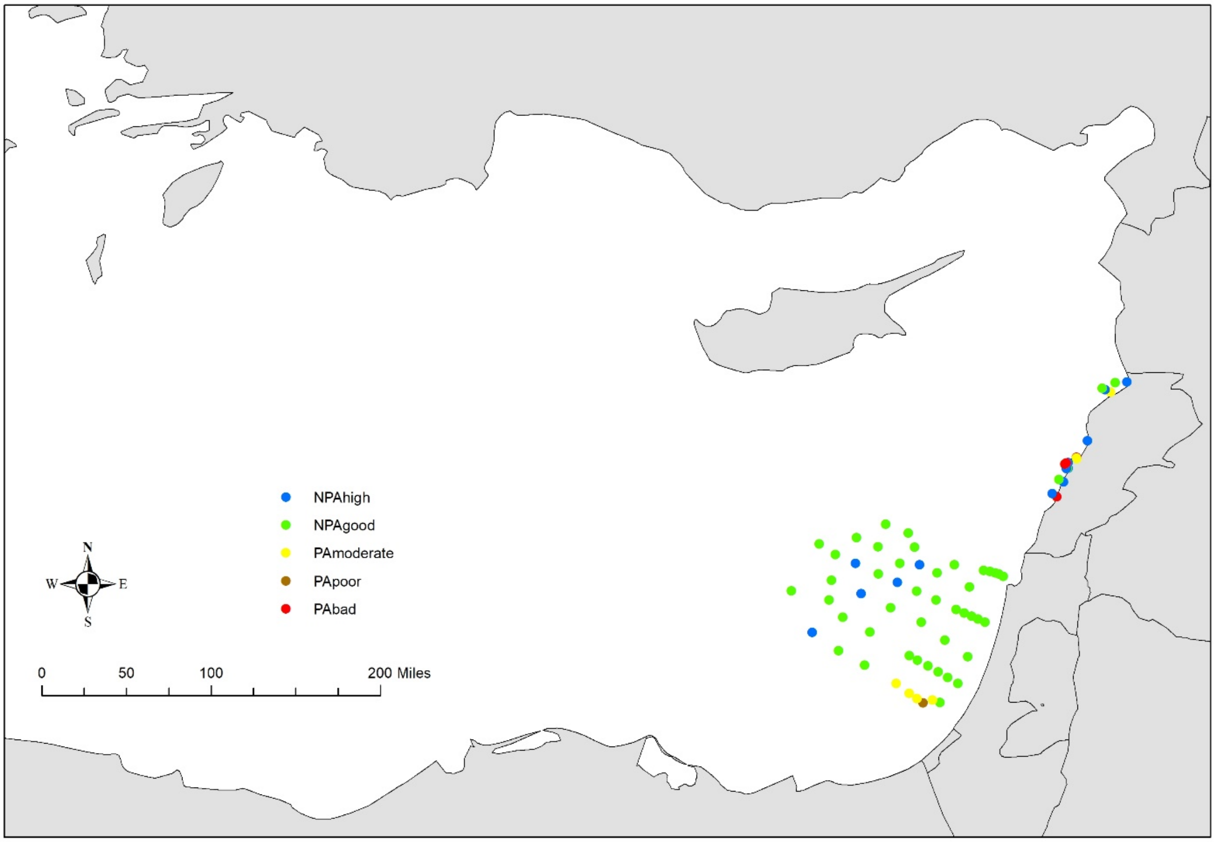

Figure 8. Results of the CHASE+ approach to assess the environmental status of Σ16 PAHs in sediments in the Levantine Basin, using AEL_BACs; stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.5); stations in yellow- PAmoderate (CS =1.5-5.0); stations in brown - PApoor (CS =5.0-10.0) and stations in red - PAbad (CS > 10.0); stations in green and yellow are considered in GES, stations in yellow, brown and red are considered in non-GES.

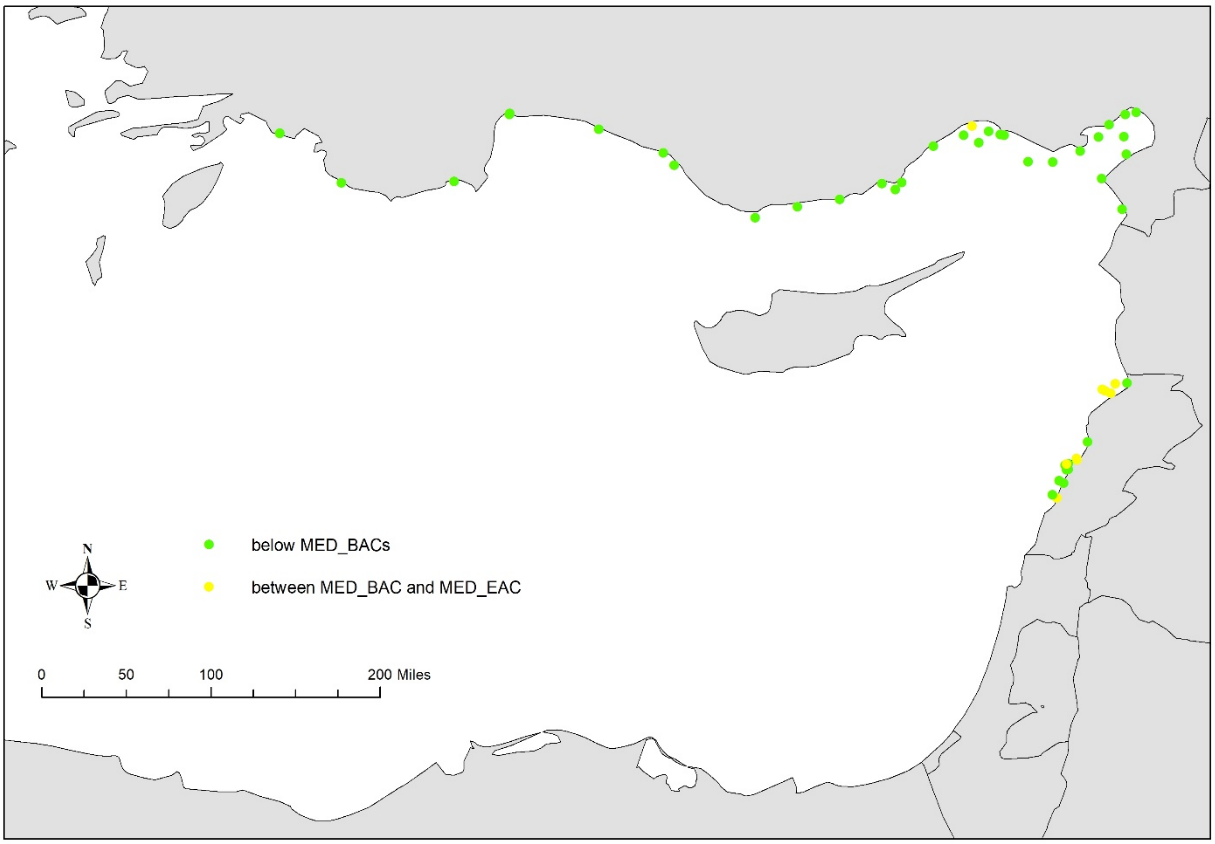

Figure 9. Results of the "traffic light" approach to assess the environmental status of Σ7 PCBs in sediments in the Levantine Sea Basin; stations n green indicate the values below MED_BACs; stations in yellow indicate the values between MED_BAC and MED_EAC; stations in red indicate the values above the MED_EAC; green and yellow stations are considered in GES, and red stations in non-GES.

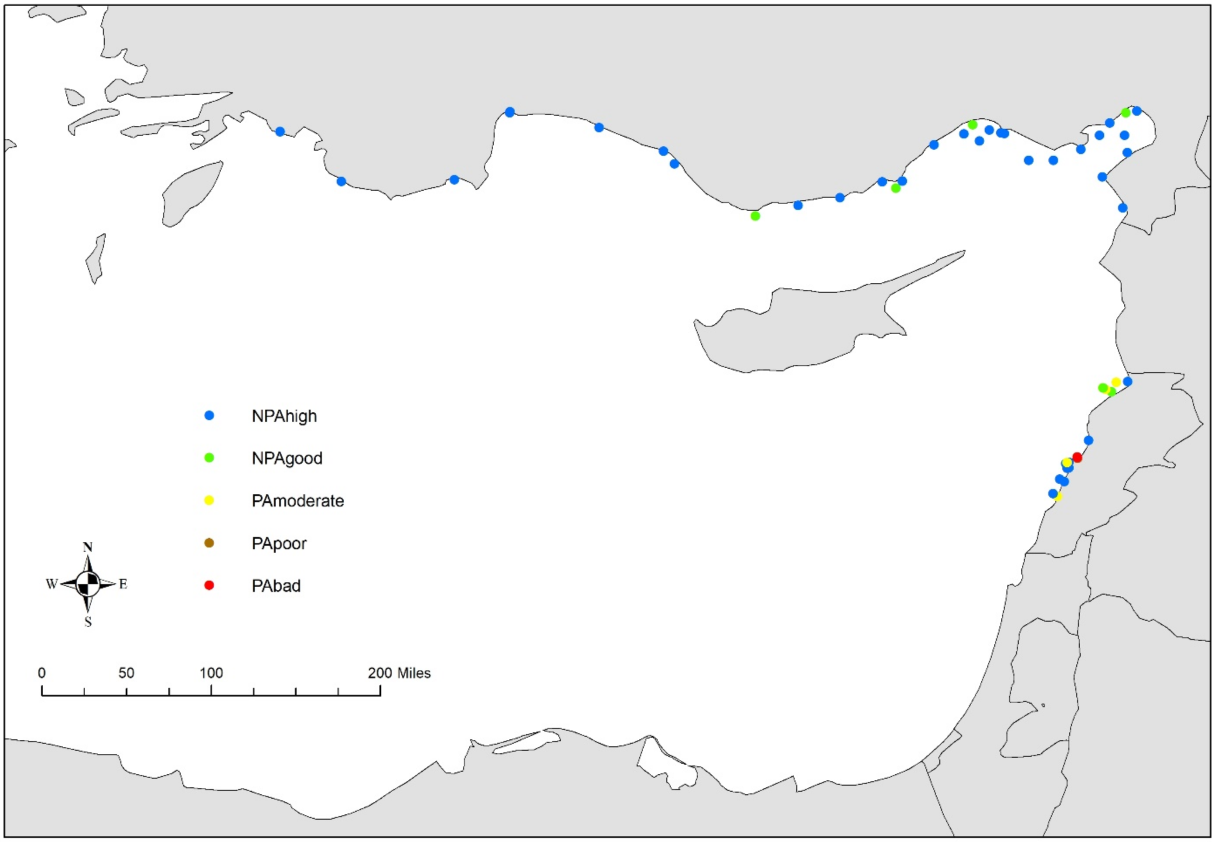

Figure 10. Results of the CHASE+ approach to assess the environmental status of Σ7 PCBs in sediments in the Levantine Sea Basin, using as threshold 3xMED_BCs; stations in blue - NPAhigh (CR=0.0-0.5); stations in green- NPAgood (CR =0.5-2.0); stations in yellow- PAmoderate (CR =2.0-5.0); stations in brown - PApoor (CR =5.0-10.0) and stations in red - PAbad (CR > 10.0); stations in blue and green stations are considered in GES, yellow, brown and red stations are considered in non-GES.

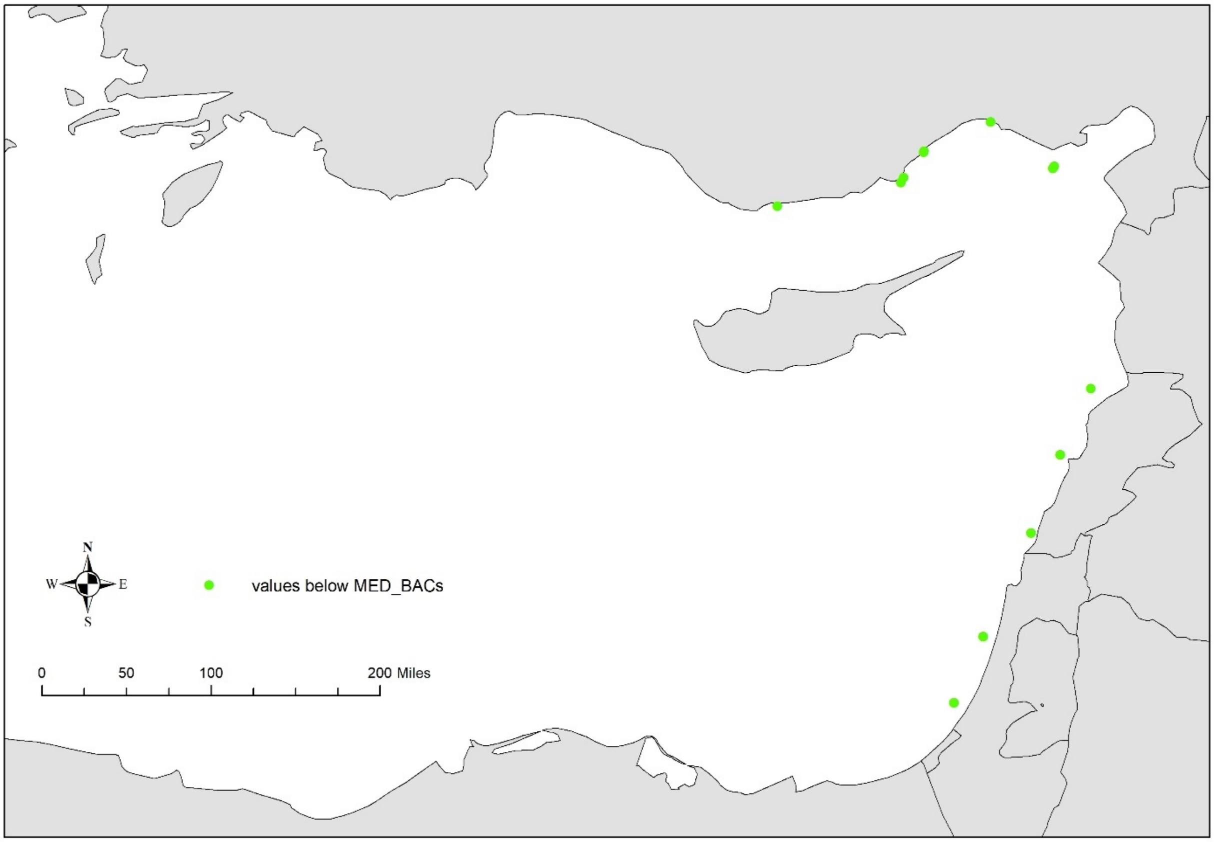

Figure 11. Results of the “traffic light” approach to assess the environmental status of Cd in M. barbatus in the Levantine Sea Basin; stations in green indicate the values below MED_BACs; stations in yellow indicate the values between MED_BAC and MED_EAC; stations in red indicate the values above the MED_EAC; stations in green and yellow are considered in GES, and stations in red are considered in non-GES.

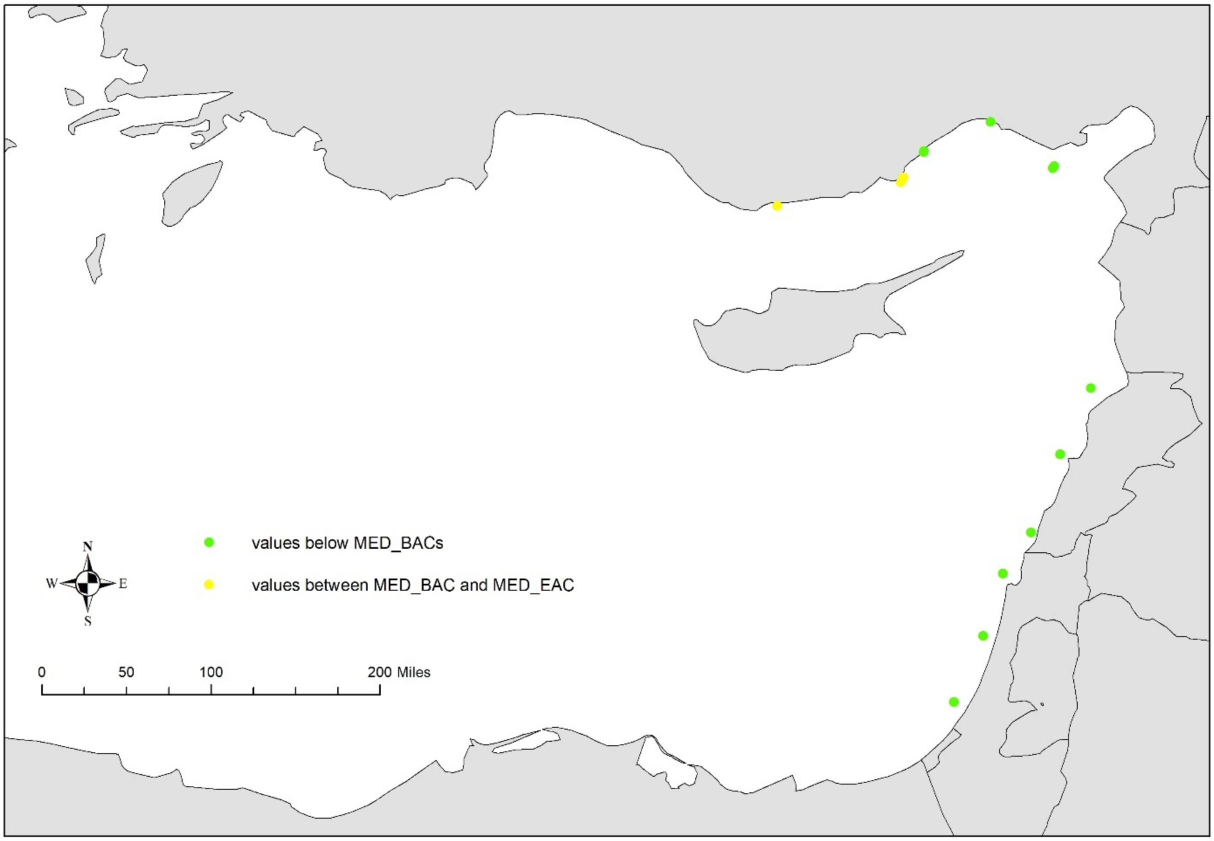

Figure 12. Results of the "traffic light" approach to assess the environmental status of Hg in M. barbatus in the Levantine Sea Basin; stations in green indicate the values below MED_BACs; stations in yellow, indicate the values between MED_BAC and MED_EAC; stations in red indicate the values above the MED_EAC; stations in green and yellow are considered in GES, and stations red are considered in non-GES.

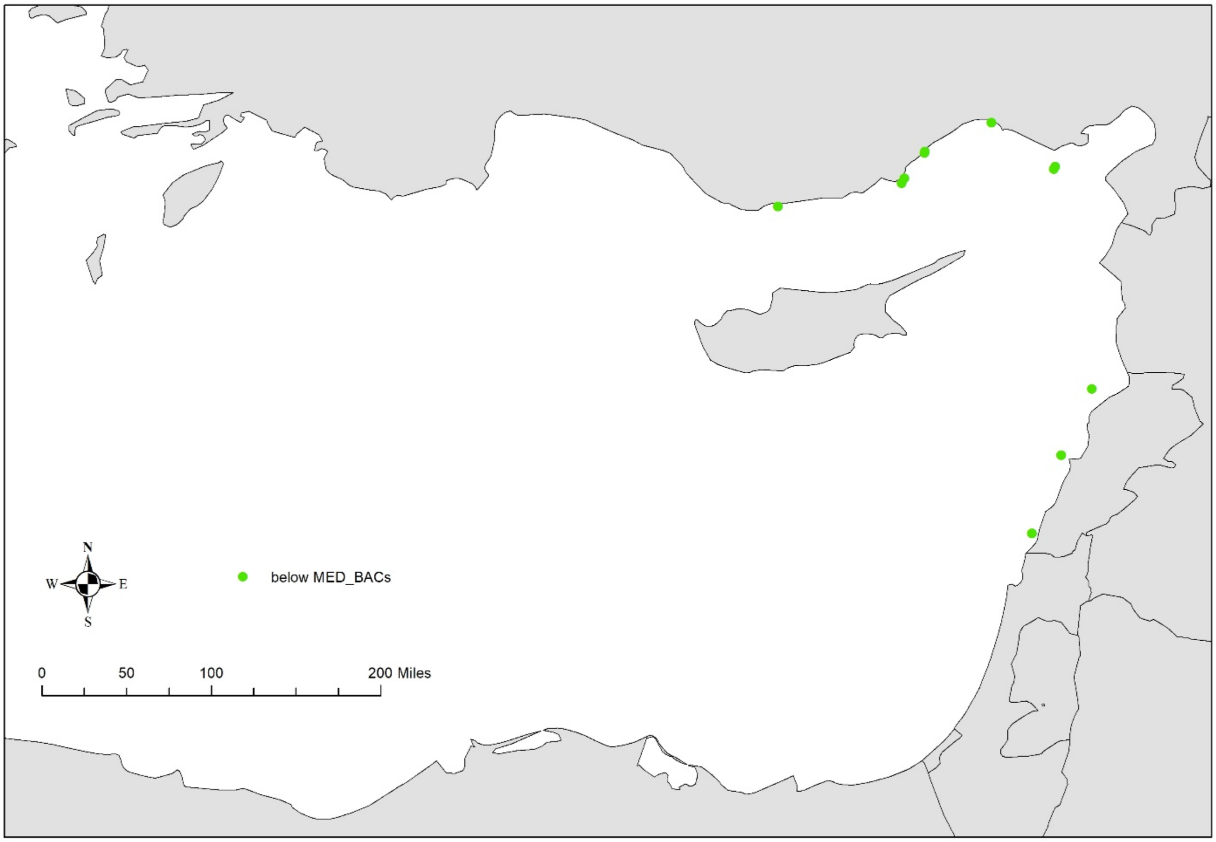

Figure 13. Results of the “traffic light” approach to assess the environmental status of Pb in M. barbatus in the Levantine Sea Basin; stations in green indicate the values below MED_BACs; stations in yellow indicate the values between MED_BAC and MED_EAC; stations in red indicate the values above the MED_EAC; stations in green and yellow are considered in GES, and stations in red are considered in non-GES.

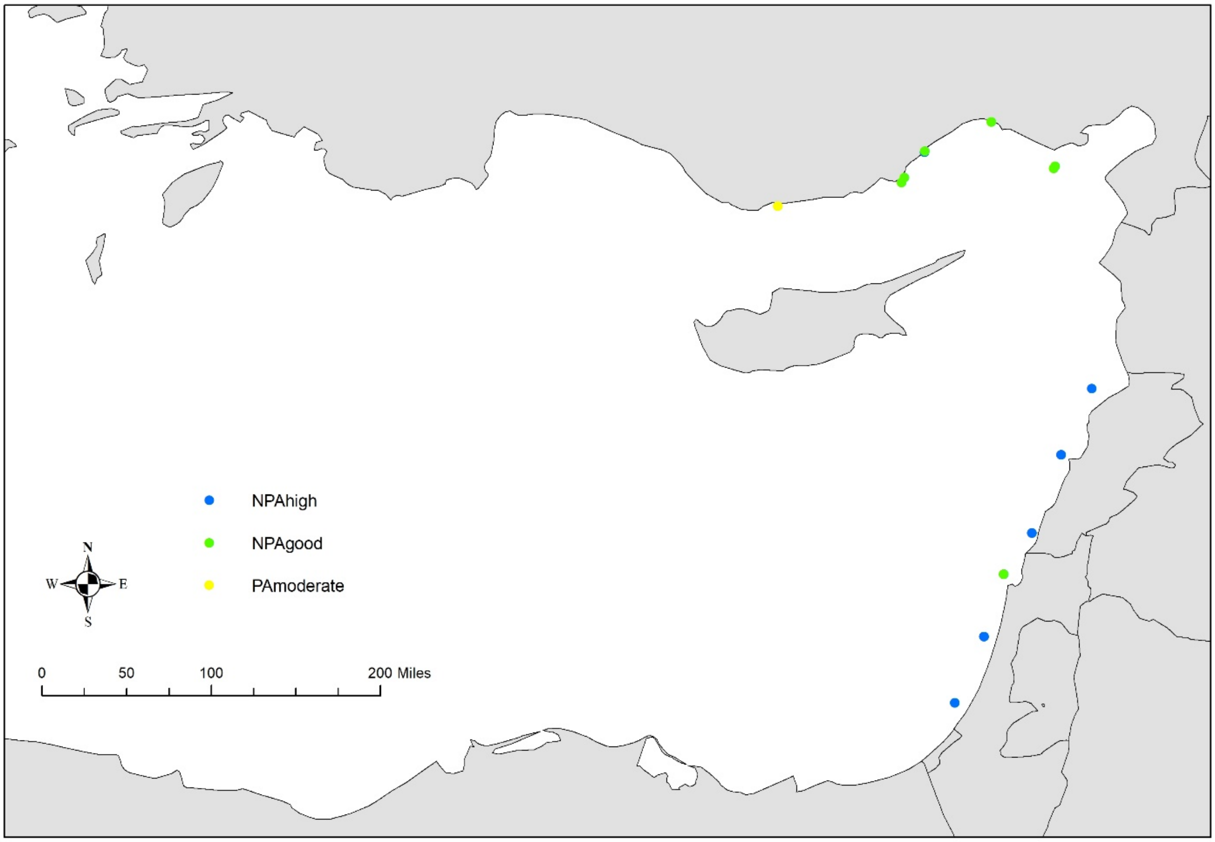

Figure 14. Results of the CHASE+ approach to assess the environmental status of trace metals (Cd, Hg, Pb) in M. barbatus in the Levantine Sea Basin, using MED_BACs; stations in Blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.5); stations in yellow- PAmoderate (CS =1.5-5.0); stations in brown - PApoor (CS =5.0-10.0) and stations in red - PAbad (CS > 10.0); stations in blue and green are considered in GES, and stations in yellow, brown and red are considered non-GES.

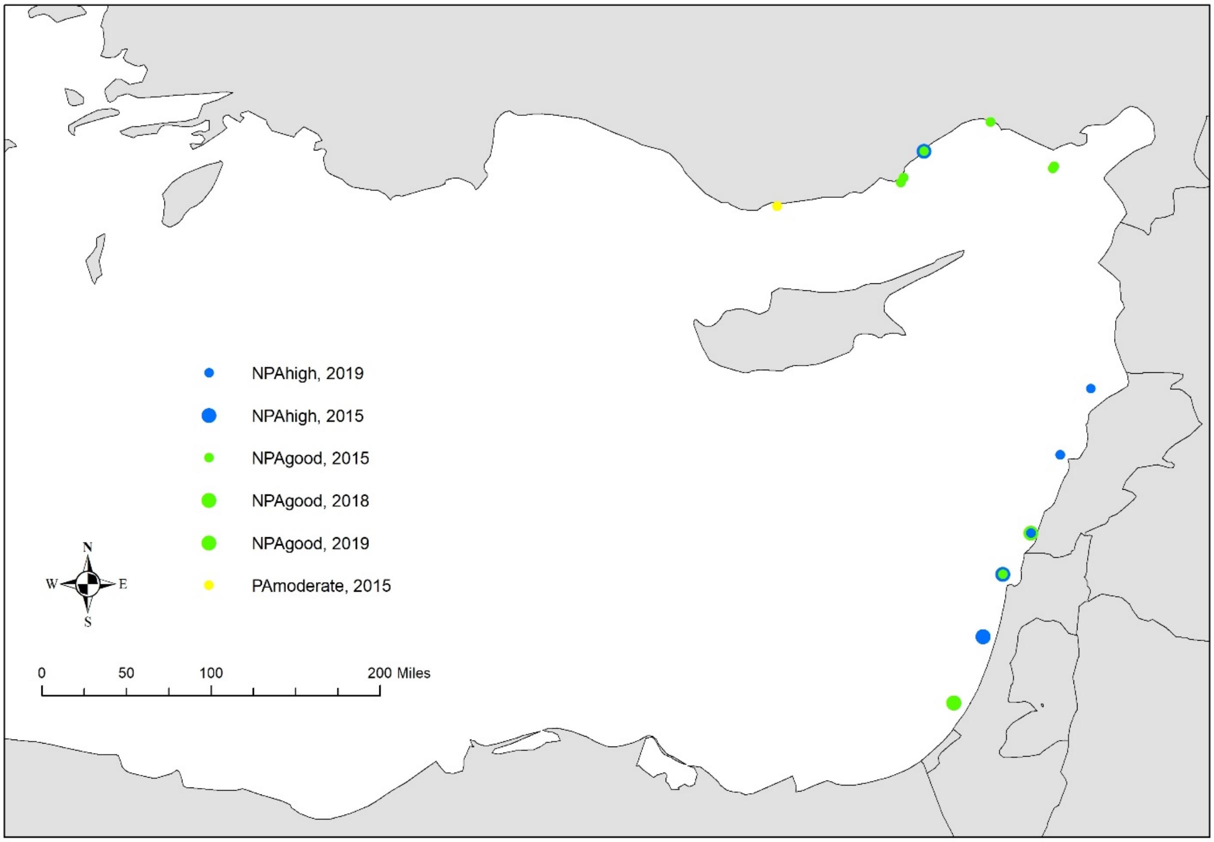

Figure 15. Results of the CHASE+ approach to assess the environmental status of trace metals (Cd, Hg, Pb) in M. barbatus in the Levantine Sea Basin, using AEL_BACs; stations in blue - NPAhigh (CS=0.0-0.5); stations in green- NPAgood (CS =0.5-1.5); stations in yellow- PAmoderate (CS =1.5-5.0); stations in brown - PApoor (CS =5.0-10.0) and stations in red - PAbad (CS > 10.0); stations in blue and green stations are considered in GES, and stations in yellow, brown and red are considered in non-GES.

Annex IV

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Appendix 5

Data Standards and Data Dictionaries for IMAP Common Indicator 18

1. Introduction

1. Data Standards (DSs) are prepared in the form of Excel spreadsheets in which every column indicates a field to be filled by the data providers. Data Dictionaries (DDs) are prepared in the form of Excel spreadsheets in which every row contains information to guide the data provider. DSs and DDs are spreadsheets included in the same Excel file, downloadable from the IMAP (Pilot) info system. The data uploaded using the Data Standards will be suitable for the inclusion in the database.

2. The proposal of DSs and DDs provides broader data sets and associated dictionaries than requested as mandatory by the related IMAP Guidance Factsheets and Metadata Templates. In the Data Standards the mandatory data are represented in black and the non-mandatory ones in red. The possibility to fill in also non-mandatory fields is provided to allow the Contracting Parties that already have monitoring systems in place and collect a wider set of data to report them as the additional data. Although it is at the discretion of the Contracting Parties to decide, reporting on non-mandatory data sets is strongly encouraged to avoid knowledge gaps between IMAP and other national data flows.

3. Following the outcome of CORMONs, the finalized DSs and DDs related to the 11 Common Indicators have been uploaded in the IMAP (Pilot) Info System and the consequent changes to the data base structure have been provided. Therefore, once all the parameters and measurement units have been defined, the correspondent data flow have been activated. Following a testing phase of the IMAP (Pilot) Info System realized with the voluntary participation of interested countries, the phase I of the system implementation is officially concluded in June 2020.

4. After the finalization of the EcAp MED II Project, discussion about further modules has been started with the thematic MAP Components for each already selected Common Indicator and for the remaining ones in view of the completion of the IMAP Common Indicator set in IMAP Info System, according to the available resources specifically allocated.

5. By reviewing this document, the present meeting is expected to provide the final inputs and further reflections to tune the standards to timely allow the implementation of the correspondent data flows to be ready by June in order to complete the Common Indicator set available for the IMAP call reporting.

6. Nevertheless, given that the development of DDs for IMAP CIs, monitoring methods and data standards were progressing in parallel, close and continuous dialogue and collaboration are needed among the bodies responsible for these developments to ensure their proper alignment and coherence.

2. Data Standards and Data Dictionaries for IMAP Common Indicator 18

7. The present document provides the proposal of the Data Standards (DSs) and Data Dictionaries (DDs) for IMAP Common Indicator 18 to support data reporting regarding evaluation of the biomarkers in the Mediterranean Sea. It includes data related to three mandatory biomarkers i) Acetylcholinesterase activity (AChE); ii) Lysosomal membrane stability (LMS); iii) Micronuclei frequencies (MN); as well as data related to not mandatory biomarker iv) Stress on Stress (SoS) and other alternative-not mandatory indicators subject of voluntary reporting from the CPs.

8. The present proposal of the Data Standards (DSs) and Data Dictionaries (DDs) for IMAP Common Indicator 18 builds on the documents that have been previously agreed: i) IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21 (UNEP/MED WG.467/5) and ii) IMAP Monitoring Guideline for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20 (UNEP/MED WG.492/8).

3. Module PMO1 - Level of pollution effects

9. Similarly to procedure established for CIs 13, 14 and 17, the following two procedures on reporting monitoring data related to IMAP CI18 are provided in the present proposal of DSs and DDs for IMAP CI 18: a) reporting data related to sampling stations and b) reporting data related to

biomarkers. Namely, the Module PMO1 includes the data both on stations and biomarkers, as well as the list of reference species and mandatory biomarkers. The two species Mytilus sp. and Mullus barbatus are considered mandatory in line with IMAP.

10. The present proposal builds on the initial proposal of DDs and DSs for IMAP CI 18, as provided in the document UNEP/MED WG.492/8 that was discussed at the Meeting of CorMon on Pollution Monitoring (26-28 April 2021) and further revised in line with the comments of CPs received during that meeting. It includes the changes introduced to address the comments provided from the participants of the Meeting of CorMon Pollution Monitoring, as well additional fields added to allow the correct functioning of the data flow and analogy with DDs and DSs for other CIs.

11. The list of reference species provided in Table 3 represents the list of species approved for the IMAP CI 17 by the 7th Meeting of the Ecosystem Approach Coordination Group and consequently made operational for data reporting for DSs & DDs for EO9 within IMAP Info System.

Table 1: DSs & DDs **Module PMO1** (Level of pollution effects) for IMAP CI 18: **Stations**

Field	Description	List of value
CountryCode	Enter member country code as ISO two digits, for example "IT" for Italy.	
NationalStationID	Station code	
NationalStationName	Station name	
*Region	Administrative subdivision of the first level where the station belongs to (according to the country subdivision)	
Latitude	Latitude of the station in the WGS84 decimal degrees reference system with at least 5 digits (xx.xxxxx).	
Longitude	Longitude of the station in the WGS84 decimal degrees reference system with at least 5 digits (xx.xxxxx). Use positive values without '+' before numbers (for ex. 13.98078) for coordinates east of the of the Greenwich Meridian (0°) and negative values with '-' for coordinates west of the Greenwich Meridian (0°) (for ex. -2.6893).	
*ClosestCoast	Station distance from the coast in km	
TCMMatrix	Environmental matrix measured in the station, enter one of the values in the list.	B = Biota
SeaDepth	Sea depth in meters	
AreaTypology	Indicate the typology of the monitored area, enter one of the values in the list	R = Reference sites C = Coastal HS = Hot spot O = Others
Pressure Type	If the monitoring station is dedicated to monitoring of pressure, indicate the typology of pressure monitored, enter one of the values in the list	AG = Agriculture and livestock IP = Industrial Plants MN = Mining MT = Maritime Traffic
Remarks	Notes	

* non-mandatory under IMAP Guidance Factsheets

Table 2: DSs & DDs **Module PMO1** (Level of pollution effects) for IMAP CI 18 –**Biomarkers**

Field	Description	List of value
CountryCode	Member country code as ISO two digits, for example "IT" for Italy.	

Field	Description	List of value
NationalStationID	Station code.	
Year	Year of sampling in YYYY format	
Month	Month of sampling in 1-12 format	
Day	Day of sampling in 1-31 format	
Time	Hours-minutes-seconds of sampling in HH:MM:SS format	
SampleID	Sample Code if multiple replies are made with the same value as Year, Month, Day and Time"	
SampleType	Wild/Caged (add information about the collection site)	
Matrix	Sample matrix, enter one value of the list	B = Biota
SampleDepth	Sampling depth in meters	
* Salinity	Salinity (psu)	
* Temperature	Temperature (°C)	
* DissolveOxygen	Dissolved oxygen (µmol O_2/l)	
SpeciesID	Monitored species. Enter one value of the column 'ID_Species' of the list 'List_species'	
SpeciesName	Monitored species. Enter one value of the column 'Label' of the list 'List_species'	
SpeciesNameOther	Name of the species, if not included in the list 'List_species'	
*SpeciesGender	Gender of the species. Enter one value of the List of values.	M = male F = female U = undefined
MaturationKey	Maturation degree of the gonads for demersal species according to the Workshop on Sexual Maturity Sampling (ICES WKMAT 2007). Enter one value of the List of values.	I= Inactive II = Maturing III= Spawning IV= Post-spawning
Specimen_lenght	Lenght of specimen in cm. In case of pooling, indicate mean lenght. (precision at 0,1 cm). In the case of fish, this value refers to the total length; for mussels it refers to the length of the valve; for crustaceans it refers to the length of the carapace.	
Specimen_length_SD_SE	Standard deviation/standard error of average length of specimens in a pool in cm. The standard deviation (SD) is a	

Field	Description	List of value
	measure of variability. The standard error of the sample depends on both the standard deviation and the sample size.	
Specimen_weight	Somatic Wweight of specimen in g. In case of pooling, indicate mean weight. (precision at 0,1 g)	
Pooling Y, N	Specify if information entered refer to polling or not; enter one of values	Y=Yes (Pooling) N=No (Single individuals)
Specimen_weight_SD_SE	Standard deviation/standard error of average weight of specimens in a pool in g.	
Pooling	In case of pooling, describe the contentof pooling andother methodological issues	
Pooling_N	Specify the number of specimens pooled	
Pooling_SD_SE	Specify which statistical measure is provided. Enter one value of the List of values.	**SD** = Standard Deviation **SE** = Standard Error
*Liver_weight	Weight of liver in grammes (precision at 0,01 g) to define hepatosomatic index (HSI)	
*Gonad_weight	Weight of Gonad in grammes (precision at 0,01 g) to define gonadosomatic index (GSI)	
Tissue	Tissue element of the monitored species, enter one of the values in the list.	**BL** = Fluids - Blood. Includes erythrocytes, haemocytes, serum (blood component without cells and clotting factors) and plasma (serum including clotting factors) **EG** = Eggs. Includes bird eggs and fish eggs (roe). Use the remarks field to provide additional information, if necessary. **GO** = Organs - Gonads. Includes female gonads (ovaries) and male gonads (testes). Use the remarks field to provide additional information, if necessary. **LI** = Organs - Liver. Includes hepatopancreas. Use the remarks field to provide additional information, if necessary. **MU** = Tissues - Muscle. Any type of muscle tissue or organ. Includes the former code TM for "Tail muscle". **ST** = Tissues - Soft tissue. Includes any body tissue except mineralised tissue (hard tissue) **GI** = Organs - Gills

Field	**Description**	**List of value**
		OT = Other. Use the remarks field to provide additional information, if necessary.
Tissue_weight	Weight of tissue in g. In case of pooling, indicate mean weight.	
Tissue_weight_SD_SE	Standard deviation/standard error of average weight of specimens in a pool in g.	
AnalyticalMethod	Analytical method used. Reference methodological protocol used for analysis – indicate method elaborated in Monitoring Guideline/Protocols for Biomarker Analysis (UNEP/MED WG. 492/4-5); Add any other methods different from these by specifying name of scientific paper	
Biomarker_Name	Name of biomarker. Enter one value of the column 'Biomarkers' of the list 'List_Biomarkers'	
Biomarker_Name_NM	Specify the name of biomarker if the 'Biomarker_Name' field has been filled in with 'NM'	
Biomarker_Value	Value of each biomarker. Precision to the second decimal place (e.xg.:0,01), except for MN where the precision is to the first decimal place (e.g.::0, 1) and for LMS-HEXO and for LMS-NRRT where the precision is to the integer number (ex.g.:1).	
Biomarker_Unit	Unit of measure (different for each biomarker). Enter one of the values in the List of Values. For the 'LMS biomarker' the unit of measure is 'min' both in the case of LMS-HEXO and LMS-NRRT but, in the first case it refers to 'labilization time' in the second case it refers to 'retention time'. If the CP wishes to report data on Additional – not Mandatory ~~Biomarkers, other~~Biomarkers, other than mandatory biomarkers insert 'NM' and specify unit of measure in the 'Biomarker_Unit_NM' field. ~~biomarker.~~	min = Lysosomal Membrane Stability (LMS) (labilization /retention minutes) nmol/min/mg protein = Acetylcholinesterase (AChE) activity ~~(nmol/min/mg protein in gills (bivalves))~~ % = Mean percentage lysosomal membrane stability in mussel (%LMS) number of cases /1000 cells = Micronucleus test (MN)(frequency) ~~µg/g = Metallothioneins level (MT) (µg/g digestive gland)~~ ~~LT50 (days) = Stress on Stress (SoS)~~

Field	Description	List of value
		NM = unit for additional not mandatory biomarker
Biomarker_Unit_NM	Unit of measure for 'Biomarker_Name_NM'. Fill in this field if the 'Biomarker_Unit' field has been filled in with 'NM'. For example, in case of EROD, SoS and MT (that are additional not mandatory biomarkers), 'Biomarker_Unit' field has to be compiled with 'NM', and this filed with the unit of specific biomarker, for example: - EROD: pmol/min/mg microsomal protein; - µg/g tissue w.w; Metallothioneins level (MT) (µg/g digestive gland); - LT50 (days) = Stress on Stress (SoS).	
Remarks	Notes	

* non-mandatory under IMAP Guidance Factsheets

Table 3: DSs&DDs Module PMO1 (Level of pollution effects) for IMAP CI 18 – List of species [1]

ID_Species	Label
8006460	*Anarhichas lupus*
2392194	*Anarhichas minor*
5212973	*Anguilla anguilla*
2389391	*Aphanopus carbo*
2440728	*Balaenoptera acutorostrata*
2420330	*Bathyraja brachyurops*
2401415	*Bathysaurus ferox*
5210955	*Boops boops*
2415752	*Boreogadus saida*
2415505	*Brosme brosme*
2481312	*Cepphus grylle*
2286583	*Cerastoderma edule*
2336668	*Chelidonichthys kumu*
2417343	*Chimaera monstrosa*
8351946	*Clupea harengus*
2403490	*Conger conger*
5215150	*Coryphaenoides rupestris*
2222188	*Crangon crangon*

[1] List of available reference species (Code list) for EO9/CI 17.

ID_Species	Label
8534921	*Crassostrea angulata*
2286069	*Crassostrea gigas*
5220003	*Delphinapterus leucas*
8324617	*Delphinus delphis*
5729032	*Donax trunculus*
2287072	*Dreissena polymorpha*
2287250	*Ensis siliqua*
2336597	*Eutrigla gurnardus*
7832266	*Fucus*
3196291	*Fucus ceranoides*
3196437	*Fucus serratus*
8222574	*Fucus vesiculosus*
2481433	*Fulmarus glacialis*
8084280	*Gadus morhua*
2415827	*Gadus ogac*
2440596	*Globicephala melas*
5213996	*Glyptocephalus cynoglossus*
2376483	*Gobius*
7788295	*Haematopus ostralegus*
2434806	*Halichoerus grypus*
2293076	*Haliotis tuberculata*
2409108	*Hippoglossoides platessoides*
2279156	*Holothuria tubulosa*
2357093	*Hoplostethus atlanticus*
2481126	*Larus*
2481156	*Larus glaucoides*
2481127	*Larus hyperboreus*
2409391	*Lepidorhombus whiffiagonis*
2419875	*Leucoraja naevus*
5213960	*Limanda limanda*
2301117	*Littorina littorea*
2415070	*Lophius budegassa*
2415075	*Lophius piscatorius*
2291262	*Lymnaea palustris*
2286995	*Macoma balthica*
5214420	*Mallotus villosus*
2415822	*Melanogrammus aeglefinus*
2415788	*Merlangius merlangus*
2415643	*Merluccius merluccius*
2415777	*Micromesistius poutassou*
5214022	*Microstomus kitt*
5214883	*Molva dypterygia*
5214880	*Molva molva*
5220008	*Monodon monoceros*

ID_Species	Label
4284897	*Mullus barbatus*
7791733	*Mya arenaria*
7865139	*Mya truncata*
2333785	*Myoxocephalus scorpius*
841	*Mysida*
2285679	*Mytilus*
8288896	*Mytilus edulis*
2285683	*Mytilus galloprovincialis*
2303019	*Nassarius reticulatus*
2226962	*Nephrops norvegicus*
5193449	*Nucella lapillus*
2286060	*Ostrea edulis*
2224987	*Palaemon serratus*
2222355	*Pandalus borealis*
2285980	*Pecten maximus*
2409966	*Pegusa lascaris*
8140485	*Perca fluviatilis*
2434773	*Phoca hispida*
2434793	*Phoca vitulina*
2440669	*Phocoena phocoena*
2409330	*Platichthys flesus*
7700106	*Pleuronectes platessa*
2415872	*Pollachius pollachius*
2415861	*Pollachius virens*
2409416	*Psetta maxima*
5216024	*Raja clavata*
5216014	*Raja montagui*
5216208	*Raja radiata*
2409383	*Reinhardtius hippoglossoides*
2481205	*Rissa tridactyla*
5175681	*Saduria entomon*
7595433	*Salmo salar*
8215487	*Salmo trutta*
4284021	*Salvelinus alpinus*
2413224	*Sardina pilchardus*
2374149	*Scomber scombrus*
2409403	*Scophthalmus rhombus*
2418684	*Scyliorhinus canicula*
2335392	*Sebastes marinus*
2335427	*Sebastes mentella*
5214139	*Solea solea*
2498352	*Somateria mollissima*
2413452	*Sprattus sprattus*
5216368	*Squalus acanthias*
5229227	*Sterna hirundo*

ID_Species	Label
2373946	*Thunnus alalunga*
2373980	*Thunnus thynnus*
8635	*Triglidae*
2481342	*Uria aalge*
2481339	*Uria lomvia*
2433451	*Ursus maritimus*
2287751	*Venerupis decussata*
2287753	*Venerupis philippinarum*
7744449	*Zeus faber*
2381013	*Zoarces viviparus*

Table 4: DSs & DDs **Module PMO1** (Level of pollution effects) for IMAP C.I. 18 – **List of Biomarkers**

Biomarker	**Description (EN)**	**Organism**	**Tissue**	**Mandatory**	**Additional (Not-mandatory)**
LMS-HEXO	Lysosomal membrane stability on cryostat sections - enzymatic determination	Fish/Mussel	Liver/Digestive gland	Y	
LMS-NRRT	Lysosomal membrane stability in mussel haemocytes - in vivo determination (neutral red retention time (NRRT) assay)	Mussel	Haemocytes (in vivo)	Y	
MN_F	Micronuclei frequency in fish blood cells	Fish	Erythrocytes	Y	
MN_MH	Micronuclei (MNi) frequency in mussel gill cells and haemocytes	Mussel	Gill cells, Haemocytes	Y	
AChE	Acetylcholinesterase activity - enzymatic determination	Mussel / Fish	Gills / Muscle	Y	
% LMS	% LMS Mean percentage of Lysosomal membrane stability in mussel	Mussel	Haemocytes		Y
MT	Metallothioneins	Mussel~~Fish~~	Digestive gland		Y
SoS	Stress on stress	Mussel	Whole organism		Y
EROD	Ethoxyresorufin-o-deethylase activity	Fish	Liver		Y
NM	Other: not mandatory biomarker	Specify	Specify		Y

Appendix 6

Data Standards and Data Dictionaries for IMAP Common Indicator 20

1. Introduction

1. Data Standards (DSs) are prepared in the form of Excel spreadsheets in which every column indicates a field to be filled by the data providers. Data Dictionaries (DDs) are prepared in the form of Excel spreadsheets in which every row contains information to guide the data provider. DSs and DDs are spreadsheets included in the same Excel file, downloadable from the IMAP (Pilot) info system. The data uploaded using the Data Standards will be suitable for the inclusion in the database.

2. The proposal of DSs and DDs provides broader data sets and associated dictionaries than requested as mandatory by the related IMAP Guidance Factsheets and Metadata Templates. In the Data Standards the mandatory data are represented in black and the non-mandatory ones in red. The possibility to fill in also non-mandatory fields is provided to allow the Contracting Parties that already have monitoring systems in place and collect a wider set of data to report them as the additional data. Although it is at the discretion of the Contracting Parties to decide, reporting on non-mandatory data sets is strongly encouraged to avoid knowledge gaps between IMAP and other national data flows.

3. Following the outcome of CORMONs, the finalized DSs and DDs related to the 11 Common Indicators have been uploaded in the IMAP (Pilot) Info System and the consequent changes to the data base structure have been provided. Therefore, once all the parameters and measurement units have been defined, the correspondent data flow have been activated. Following a testing phase of the IMAP (Pilot) Info System realized with the voluntary participation of interested countries, the phase I of the system implementation is officially concluded in June 2020.

4. After the finalization of the EcAp MED II Project, discussion about further modules has been started with the thematic MAP Components for each already selected Common Indicator and for the remaining ones in view of the completion of the IMAP Common Indicator set in IMAP Info System, according to the available resources specifically allocated.

5. By reviewing this document, the present meeting is expected to provide the final inputs and further reflections to tune the standards to timely allow the implementation of the correspondent data flows to be ready by June in order to complete the Common Indicator set available for the IMAP call reporting.

6. Nevertheless, given that the development of DDs for IMAP CIs, monitoring methods and data standards were progressing in parallel, close and continuous dialogue and collaboration are needed among the bodies responsible for these developments to ensure their proper alignment and coherence.

2. Data Standards and Data Dictionaries for IMAP Common Indicator 20: Levels of contaminants in seafood

7. The present document provides proposal of the Data Standards and Data Dictionaries (DSs & DDs) aimed at collecting data on actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood in the Mediterranean Sea.

8. As it is explained in IMAP Guidance factsheet for IMAP CI 20, its implementation beyond food consumer protection and public health would need to be determined Thus, monitoring protocols, risk-based approaches, analytical testing and assessment methodologies would need to be further examined by the Contracting Parties` national food safety authorities, research organisations and/or environmental agencies.

9. The reference documents used as a basis for proposing this DSs and DDs, including the species to be monitored, are the following:

i. IMAP Common Indicator Guidance Facts Sheets (Pollution and Marine Litter) (UNEP/MED WG.444/5);

ii. IMAP Guidance Factsheets: Update for Common Indicators 13, 14, 17, 18, 20 and 21 (UNEP/MED WG.467/5);

iii. IMAP Monitoring Guideline for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20 (UNEP/MED WG.492/8).

3. Module PSF1: Levels of contaminants in seafood

10. One of the potential risks associated with the occurrence of harmful substances (chemicals, nanoparticles, microplastics, toxins) in the marine environment is the human exposure through commercial fish and shellfish species (primarily, from wild fisheries and aquaculture). These organisms are exposed to environmental contaminants which enter their organism through different mechanisms and pathways according their thropic level, which include from filter feeding to predatory strategies (crustaceans, bivalves, fish). Consequently, there exist both bioaccumulation and biomagnification processes of these chemicals released in the marine environment. Common examples are well-known regarding bioaccumulation of metals and organic compounds in commercial bivalve species (such as the Mytilus galloprovincialis in the Mediterranean Sea) or alkyl mercury compounds (methylmercury) in tuna fish; the impacts of new and emerging contaminants should also be considered in the near future.

11. For IMAP CI 20, contaminants' levels should also be expressed in absolute figures and not only in relation to the regulatory level (i.e. above or below the regulatory level). Regulatory levels for the protection of human health as presented in EU Regulations (EC) No 1881/2006, (EC) No 835/2011 and EC No 1259/2011 (Annex III) are usually high in relation to the normal ambient concentrations of contaminants in marine organisms. However, recording the absolute concentration (and not the relative above/below the regulatory level information) triggers a warning signal in the event of an ascending trend of contaminants concentrations, even if these concentrations are still below the regulatory limit. It must be underlined that concentrations below regulatory levels are not necessarily indicators of good environmental status, since environmental effects might be present at lower concentrations (JRC, 2010). Furthermore, recording the absolute concentration of pollutants generate data for contaminants, which may not be regulated yet but which might be regulated in the future.

12. The concentration limits for the regulated contaminants in the EU as presented in a concise format in Annex I have been considered for preparing this proposal of DDs and DSs for IMAP CI 20 in line with the conclusion of the Meeting of CorMon on Pollution Monitoring that was held from 26 to 28 April 2021. The list of contaminants includes Cd, Hg, Pb, four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene), dioxins, dioxin-like 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.

13. Integration of monitoring data for CI 20 have been made with care. JRC (2010) 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 or 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" (JRC, 2010). If regulatory levels are exceeded in one species, that doesn't mean that all seafood consumption from this sub-region is dangerous.

14. In line with above, the initial proposal of the elements that have been agreed by the Meeting of CorMon on Pollution Monitoring were used for preparing this proposal of the Data Standards (DS) and Data Dictionaries (DDs) specific for CI 20 as provided here-below.

15. The module PSF1 for reporting on the monitoring data for IMAP CI 20 into the IMAP Info System allows collecting data related to the type of contaminants detected in sea food, the actual levels detected and the exceeding of the regulatory levels for consumption by humans. This data along with the information on the time of sampling ensures evaluation of the frequency of the contaminants' concentration exceedance of the regulatory limits.

16. The DSs developed for this Module should allow to collect all data for the necessary statistical treatments and long-term time-trend evaluations.

17. The DSs and DDs related to IMAP CI 20 for characteristic parameters including contaminants information and the List of reference on chemicals are based on the DDs (contaminants information) which have been developed for IMAP CI17 (UNEP/MED WG.467/8).

18. The list of reference for chemicals proposed for IMAP CI 20 (Table 3) is also in use by the European Environmental Agency (EEA, WISE-Marine) and includes either the CAS numbers (Chemical Abstract Service reference number) or the EEA reference number (for particular EEA requirements). The mandatory contaminants[1] are represented in black (Cd, Hg, Pb, four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene), dioxins, dioxin-like and non dioxin-like PCBs and radionuclides) and the non-mandatory ones in red color.

19. The list of commercial species reported in Table 4Table 4 refers to JRC list of marine species of commercial interest in the different Mediterranean Regions (Marine strategy framework directive Task group 9 contaminants in fish and other seafood, April 2010).[2]

20. If any species is not present among those listed, it is always possible to insert related data by filling in the SpeciesNameOther field.

Table 1: DSs & DDs Module PSF1 (Levels of contaminants in seafood for IMAP CI20: Stations

Field	Description	List of value
CountryCode	Member country code as ISO two digits, for example "IT" for Italy.	
NationalStationID	Specify the station code of the sample collection. In case information on location of collection is not available, then provide code of the fishing area. Specifically, in the case of fishing area, insert one of the Geographical Subarea number present in the 'Value' column of the Excel sheet 'List_GSA'.	
NationalStationName	Specify the station name of the sample collection. In case information on location of collection is not available, then provide name of the fishing area. Specifically, in the case of fishing area, insert one of the Geographical Subarea name present in the 'Description' column of the Excel sheet 'List_GSA'.	
*Region	Administrative subdivision of first level which the station belongs to (according to the country subdivision)	

[1] This list has been included in Annex III of the Monitoring Guideline for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20 (UNEP/MED WG. 492/08)
[2] This list has been included in Annex I of the Monitoring Guidelines/Protocols for Sampling and Sample Preservation of Sea Food for IMAP Common Indicator 20: Heavy and Trace Elements and Organic Contaminants (UNEP/MED WG. 482/17)

Field	Description	List of value
Latitude	Latitude of the sample collection in the WGS84 decimal degrees reference system with at least 5 digits (xx.xxxxx). In case information on location of collection is not available, then provide the latitude of the centroid of the Fishing Area, referring to the Geographical Subarea (GSA) specified in NationalStationID.	
Longitude	Longitude of the sample collection in the WGS84 decimal degrees reference system with at least 5 digits (xx.xxxxx). Use positive values without '+' before numbers (for ex. 13.98078) for coordinates east of the of the Greenwich Meridian (0°) and negative values with '-' for coordinates west of the Greenwich Meridian (0°) (for ex. -2.6893). In case information on location of collection is not available, then provide the longitude of the centroid of the Fishing Area, referring to the Geographical Subarea (GSA) specified in NationalStationID.	
SampleCollectionType	Specify if the geographical information, entered in "Latitude" and "Longitude" fields, refers to the collection location (CL) or to the fishing area (FA), in case information on location of collection is not available. Enter one value in the list.	CL = Collection Location FA = Fishing Area
*ClosestCoast	Station distance from the coast in km	
TCMMatrix	Environmental matrix measured in the station, enter one of the values in the list.	B = Biota
SeaDepth	Sea depth in meters	
AreaTypology	Indicate the typology of the monitored area, enter one of the values in the list	R = Reference sites C = Coastal HS = Hot spot O = Others
Remarks	Notes	

* non-mandatory under IMAP Guidance Factsheets

Table 2: DSs & DDs Module PSF1 (Levels of contaminants in seafood) for IMAP CI 20: Contaminants

Field	Description	List of value
CountryCode	Member country code as ISO two digits, for example "IT" for Italy.	
NationalStationID	Specify the station code of the sample collection. In case information on location of collection is not available, then provide code of the fishing area. Specifically, in the case of fishing area, insert one of the Geographical Subarea number present in the 'Value' column of the Excel sheet 'List_GSA'.	
Year	Year of sampling in YYYY format	
Month	Month of sampling in 1-12 format	
Day	Day of sampling in 1-31 format	

Field	Description	List of value
Time	Hours-minutes-seconds of sampling in HH:MM:SS format	
SampleID	Sample Code if multiple sampling are made with the same value as Year, Month, Day and Time.	
Matrix	Sample matrix, enter one value of the list	B = Biota
SampleDepth	Sampling depth in meters	
Salinity	Salinity (psu)	
Temperature	Temperature (°C)	
DissolveOxygen	Dissolved oxygen (µmol O2/l)	
SpeciesID	Monitored species. Enter one value of the column 'ID_Species' of the list 'List_species'	
SpeciesName	Monitored species. Enter one value of the column 'Label' of the list 'List_species'	
SpeciesNameOther	Name of species, in case not included in the list 'List_species'	
Specimen_lenght	Lenght of specimen in cm. In case of pooling, indicate mean lenght. (precision at 0,1 cm)	
*Specimen_lenght_sd	Standard deviation of average length of specimens in a pool in cm.	
Specimen_weight	Weight of specimen in g. In case of pooling, indicate mean weight (precision at 0,1 g)	
*Specimen_weight_sd	Standard deviation of average weight of specimens in a pool in g.	
Tissue	Tissue used to quantify contaminant concentrations	M= Muscle L= Liver G= Gonads WST=whole soft tissues O=other
Fat Content	Fat content as percentage of total wet matter	
*Pooling	In case of pooling, describe the content of pooling as number of specimens and other methodological issues, taking into consideration the sampling requirements described in IMAP Monitoring Guidelines UNEP/MED WG.482/17	
DeterminHazSubsName	Name of the contaminant, enter one value of the column 'Label' of the list 'List_contaminants'	
DeterminHazSubsID	ID of the contaminant, enter one value of the column 'ID_Contaminant' of the list 'List_contaminants'	
CASNumber	CAS number of contaminant, enter one value of the column 'CASNumber' of list 'List_contaminants'	
Concentration	Concentration value of detected contaminant (DeterminHazSubsID)	
MRL	Maximum Regulatory Level for contaminant (DeterminHazSubsID)	
HazSubs_unit	Unit of measurement for the contaminant. Enter one value of the list	mg/kg = metals ug/kg = not metals
MRL_Flag	Enter the value '>' in case the concentration value of detected contaminant is above the Maximum	> = Concentration value of detected

Field	Description	List of value
	Regulatory Level for contaminant (MRL). In the other cases, leave the field empty.	contaminant above MRL
Remarks	Notes	

* non-mandatory under IMAP Guidance Factsheets

Table 3: DSs & DDs Module PSF1 (Levels of contaminants in seafood) for CI 20: List of contaminants

ID_Contaminant	Label	CASNumber
*CAS_90-12-0	1-methylnaphthalene	90-12-0
*CAS_75-34-3	1,1-dichloroethane	75-34-3
*CAS_75-35-4	1,1-dichloroethene	75-35-4
*CAS_563-58-6	1,1-dichloropropene	563-58-6
*CAS_71-55-6	1,1,1-trichloroethane	71-55-6
*CAS_630-20-6	1,1,1,2-tetrachloroethane	630-20-6
*CAS_1070-78-6	1,1,1,3-tetrachloropropane	1070-78-6
*CAS_79-00-5	1,1,2-trichloroethane	79-00-5
*CAS_79-34-5	1,1,2,2-tetrachloroethane	79-34-5
*CAS_96-12-8	1,2-dibromo-3-chloropropane	96-12-8
*CAS_106-93-4	1,2-dibromoethane	106-93-4
*CAS_95-50-1	1,2-dichlorobenzene	95-50-1
*CAS_107-06-2	1,2-dichloroethane	107-06-2
*CAS_540-59-0	1,2-dichloroethene	540-59-0
*CAS_78-87-5	1,2-dichloropropane	78-87-5
*CAS_87-61-6	1,2,3-trichlorobenzene	87-61-6
*CAS_96-18-4	1,2,3-trichloropropane	96-18-4
*CAS_35822-46-9	1,2,3,4,6,7,8-H7CDD	35822-46-9
*CAS_67562-39-4	1,2,3,4,6,7,8-H7CDF	67562-39-4
*CAS_3268-87-9	1,2,3,4,6,7,8,9-O8CDD	3268-87-9
*CAS_39001-02-0	1,2,3,4,6,7,8,9-O8CDF	39001-02-0
*CAS_39227-28-6	1,2,3,4,7,8-H6CDD	39227-28-6
*CAS_70648-26-9	1,2,3,4,7,8-H6CDF	70648-26-9
*CAS_55673-89-7	1,2,3,4,7,8,9-H7CDF	55673-89-7
*CAS_57653-85-7	1,2,3,6,7,8-H6CDD	57653-85-7
*CAS_57117-44-9	1,2,3,6,7,8-H6CDF	57117-44-9
*CAS_40321-76-4	1,2,3,7,8-P5CDD	40321-76-4
*CAS_57117-41-6	1,2,3,7,8-P5CDF	57117-41-6
*CAS_19408-74-3	1,2,3,7,8,9-H6CDD	19408-74-3
*CAS_72918-21-9	1,2,3,7,8,9-H6CDF	72918-21-9
*CAS_120-82-1	1,2,4-trichlorobenzene	120-82-1
*CAS_95-63-6	1,2,4-trimethylbenzene	95-63-6
*CAS_3194-55-6	1,2,5,6,9,10-hexabromocyclododecane	3194-55-6
*CAS_541-73-1	1,3-dichlorobenzene	541-73-1
*CAS_142-28-9	1,3-dichloropropane	142-28-9
*CAS_542-75-6	1,3-dichloropropene	542-75-6
*CAS_108-70-3	1,3,5-trichlorobenzene	108-70-3
*CAS_108-67-8	1,3,5-trimethylbenzene	108-67-8
*CAS_25637-99-4	1,3,5,7,9,11-hexabromocyclododecane	25637-99-4
*CAS_106-46-7	1,4-dichlorobenzene	106-46-7
*CAS_123-91-1	1,4-dioxane	123-91-1
*CAS_4904-61-4	1,5,9-cyclododecatriene	4904-61-4
*CAS_57-63-6	17alpha-ethinylestradiol (EE2)	57-63-6
*CAS_50-28-2	17beta-estradiol (E2)	50-28-2
*CAS_288-88-0	1H-1,2,4-Triazole	288-88-0
*CAS_25140-90-3	2-(2,6-dichlorophenoxy)propionic acid (2,6-DCPP)	25140-90-3
*CAS_3307-39-9	2-(4-chlorophenoxy)propionic acid (4-CPP)	3307-39-9
*CAS_16672-87-0	2-chloroethylphosphonic acid	16672-87-0

ID_Contaminant	Label	CASNumber
*CAS_95-57-8	2-chlorophenol	95-57-8
*CAS_95-49-8	2-chlorotoluene	95-49-8
*CAS_5466-77-3	2-Ethylhexyl 4-methoxycinnamate	5466-77-3
*CAS_1668-54-8	2-methyl-4-amino-6-methoxy-s-triazine	1668-54-8
*CAS_95-48-7	2-methyl-phenol	95-48-7
*CAS_91-57-6	2-methylnaphthalene	91-57-6
*CAS_135-19-3	2-naphthol	135-19-3
*CAS_594-20-7	2,2-dichloropropane	594-20-7
*CAS_526-75-0	2,3-dimethyl-phenol	526-75-0
*CAS_4901-51-3	2,3,4,5-tetrachlorophenol	4901-51-3
*CAS_58-90-2	2,3,4,6-tetrachlorophenol	58-90-2
*CAS_60851-34-5	2,3,4,6,7,8-H6CDF	60851-34-5
*CAS_57117-31-4	2,3,4,7,8-P5CDF	57117-31-4
*CAS_50-31-7	2,3,6-trichlorobenzoic acid	50-31-7
*CAS_51207-31-9	2,3,7,8-T4CDF	51207-31-9
*CAS_94-82-6	2,4-DB	94-82-6
*CAS_133-53-9	2,4-dichloro-3,5-dimethylphenol	133-53-9
*CAS_120-83-2	2,4-dichlorophenol	120-83-2
*CAS_94-75-7	2,4-dichlorophenoxyacetic acid, 2-4 D	94-75-7
*CAS_105-67-9	2,4-dimethyl-phenol	105-67-9
*CAS_121-14-2	2,4-dinitrotoluene	121-14-2
*CAS_93-76-5	2,4,5-T	93-76-5
*CAS_95-95-4	2,4,5-trichlorophenol	95-95-4
*CAS_732-26-3	2,4,6-tri-tert-butylphenol	732-26-3
*CAS_36065-30-2	2,4,6-tribromophenyl 2-methyl-2,3-dibromopropy ether	36065-30-2
*CAS_88-06-2	2,4,6-trichlorophenol	88-06-2
*CAS_118-96-7	2,4,6-trinitrotoluene	118-96-7
*CAS_95-87-4	2,5-dimethylphenol	95-87-4
*CAS_2008-58-4	2,6-dichlorobenzamide	2008-58-4
*CAS_50-30-6	2,6-dichlorobenzoic acid	50-30-6
*CAS_87-65-0	2,6-dichlorophenol	87-65-0
*CAS_576-26-1	2,6-dimethyl-phenol	576-26-1
*CAS_128-37-0	2,6-Ditert-butyl-4-methylphenol	128-37-0
*CAS_16655-82-6	3-hydroxycarbofuran	16655-82-6
*CAS_59-50-7	3-methyl-4-chlorophenol	59-50-7
*CAS_55525-54-7	3,3’-(ureylenedimethylene)bis(3,5,5’- trimethylcyclohexyl) diisocyanate	55525-54-7
*CAS_95-76-1	3,4-dichloroaniline	95-76-1
*CAS_95-65-8	3,4-dimethyl-phenol	95-65-8
*CAS_108-68-9	3,5-dimethyl-phenol	108-68-9
*CAS_793-24-8	4-(dimethylbutylamino) diphenylamin (6PPD)	793-24-8
*CAS_101-55-3	4-bromophenyl phenyl ether	101-55-3
*CAS_1570-64-5	4-chloro-2-methylphenol	1570-64-5
*CAS_106-43-4	4-chlorotoluene	106-43-4
*CAS_99-87-6	4-isopropyltoluene	99-87-6
*CAS_106-44-5	4-methyl-phenol	106-44-5
*CAS_104-40-5	4-nonylphenol	104-40-5
*CAS_84852-15-3	4-nonylphenol, branched	84852-15-3
*CAS_98-51-1	4-tert-butyltoluene	98-51-1
*CAS_1570-65-6	4,6-dichloro-2-methylphenol	1570-65-6
*CAS_83-32-9	Acenaphthene	83-32-9

ID_Contaminant	Label	CASNumber
*CAS_208-96-8	Acenaphthylene	208-96-8
*CAS_160430-64-8	Acetamiprid	160430-64-8
*CAS_34256-82-1	Acetochlor	34256-82-1
*CAS_187022-11-3	Acetochlor ESA	187022-11-3
*CAS_194992-44-4	Acetochlor OA	194992-44-4
*EEA_3151-01-7	Acid neutralizing capacity	
*EEA_3153-01-3	Acid neutralizing capacity to pH 4.5	
*CAS_74070-46-5	Aclonifen	74070-46-5
*CAS_79-06-1	Acrylamide	79-06-1
*CAS_107-13-1	Acrylonitrile	107-13-1
*CAS_15972-60-8	Alachlor	15972-60-8
*CAS_142363-53-9	Alachlor ESA	142363-53-9
*CAS_171262-17-2	Alachlor OA	171262-17-2
*CAS_116-06-3	Aldicarb	116-06-3
*CAS_1646-87-3	Aldicarb sulfoxide	1646-87-3
*CAS_1646-88-4	Aldoxycarb	1646-88-4
*CAS_309-00-2	Aldrin	309-00-2
*EEA_33-01-2	Alkalised benzene	
*CAS_959-98-8	Alpha-Endosulfan	959-98-8
*CAS_319-84-6	Alpha-HCH	319-84-6
*CAS_134237-50-6	alpha-Hexabromocyclododecane	134237-50-6
*CAS_7429-90-5	Aluminium and its compounds	7429-90-5
*CAS_834-12-8	Ametryn	834-12-8
*CAS_120923-37-7	Amidosulfuron	120923-37-7
*CAS_1066-51-9	Aminomethylphosphonic acid (AMPA)	1066-51-9
*CAS_7664-41-7	Ammonia	7664-41-7
*CAS_14798-03-9	Ammonium	14798-03-9
*CAS_120-12-7	Anthracene	120-12-7
*CAS_7440-36-0	Antimony	7440-36-0
*CAS_59473-04-0	AOX	59473-04-0
*CAS_140-57-8	Aramite	140-57-8
*CAS_12767-79-2	Aroclor	12767-79-2
*CAS_7440-38-2	Arsenic and its compounds	7440-38-2
*CAS_1332-21-4	Asbestos	1332-21-4
*CAS_3337-71-1	Asulam	3337-71-1
*CAS_29122-68-7	Atenolol	29122-68-7
*CAS_1912-24-9	Atrazine	1912-24-9
*CAS_2642-71-9	Azinphos-ethyl	2642-71-9
*CAS_86-50-0	Azinphos-methyl	86-50-0
*CAS_83905-01-5	Azitromycin	83905-01-5
*CAS_131860-33-8	Azoxystrobin	131860-33-8
*CAS_7440-39-3	Barium	7440-39-3
*CAS_189084-64-8	BDE 100 (2,2’,4,4’,6-pentabromodiphenyl ether)	189084-64-8
*CAS_182677-30-1	BDE 138 (2,2’,3,4,4’,5’-hexabromodiphenyl ether)	182677-30-1
*CAS_68631-49-2	BDE 153 (2,2’,4,4’,5,5’-hexabromodiphenyl ether)	68631-49-2
*CAS_207122-15-4	BDE 154 (2,2’,4,4’,5,6’-hexabromodiphenyl ether)	207122-15-4
*CAS_68928-80-3	BDE 183 (Heptabromodiphenylether)	68928-80-3
*CAS_41318-75-6	BDE 28 (2,4,4'-tribromodiphenyl ether)	41318-75-6
*CAS_5436-43-1	BDE 47 (2,2’,4,4’-tetrabromodiphenyl ether)	5436-43-1
*CAS_182346-21-0	BDE 85 (2,2’,3,4,4’-pentabromodiphenyl ether)	182346-21-0
*CAS_60348-60-9	BDE 99 (2,2’,4,4’,5-pentabromodiphenyl ether)	60348-60-9

ID_Contaminant	Label	CASNumber
*CAS_3813-05-6	Benazolin	3813-05-6
*CAS_22781-23-3	Bendiocarb	22781-23-3
*CAS_1861-40-1	Benfluralin	1861-40-1
*CAS_83055-99-6	Bensulfuron-methyl	83055-99-6
*CAS_25057-89-0	Bentazone	25057-89-0
*CAS_71-43-2	Benzene	71-43-2
CAS_56-55-3	Benzo(a)anthracene	56-55-3
CAS_50-32-8	Benzo(a)pyrene	50-32-8
CAS_205-99-2	Benzo(b)fluoranthene	205-99-2
*CAS_191-24-2	Benzo(g,h,i)perylene	191-24-2
*CAS_207-08-9	Benzo(k)fluoranthene	207-08-9
*EEA_33-02-3	Benzol	
*CAS_95-14-7	Benzotriazol	95-14-7
*CAS_7440-41-7	Beryllium	7440-41-7
*CAS_33213-65-9	Beta-Endosulfan	33213-65-9
*CAS_319-85-7	Beta-HCH	319-85-7
*CAS_134237-51-7	beta-Hexabromocyclododecane	134237-51-7
*CAS_41859-67-0	Bezafibrate	41859-67-0
*CAS_42576-02-3	Bifenox	42576-02-3
*CAS_1163-19-5	Bis(pentabromophenyl) ether	1163-19-5
*CAS_80-05-7	Bisphenol A	80-05-7
*EEA_3133-01-5	BOD5	
*EEA_3133-02-6	BOD7	
*CAS_7440-42-8	Boron	7440-42-8
*CAS_188425-85-6	Boscalid	188425-85-6
*CAS_314-40-9	Bromacil	314-40-9
*CAS_15541-45-4	Bromate	15541-45-4
*CAS_24959-67-9	Bromide	24959-67-9
*EEA_32-04-2	Brominated diphenylethers (congener numbers 28, 47, 99, 100, 153 and 154)	
*EEA_33-04-5	Brominated flame retardants	
*CAS_108-86-1	Bromobenzene	108-86-1
*CAS_74-97-5	Bromochloromethane	74-97-5
*CAS_75-27-4	Bromodichloromethane	75-27-4
*CAS_75-25-2	Bromoform	75-25-2
*CAS_74-83-9	Bromomethane	74-83-9
*CAS_1689-84-5	Bromoxynil	1689-84-5
*CAS_1689-99-2	Bromoxynil octanoate	1689-99-2
*CAS_52-51-7	Bronopol	52-51-7
*EEA_33-05-6	BTEX	
*CAS_41483-43-6	Bupirimate	41483-43-6
*CAS_3766-60-7	Buturon	3766-60-7
*CAS_85-68-7	Butyl benzyl phthalate (BBP)	85-68-7
CAS_7440-43-9	Cadmium and its compounds	7440-43-9
*CAS_58-08-2	Caffeine	58-08-2
*CAS_7440-70-2	Calcium	7440-70-2
*CAS_133-06-2	Captan	133-06-2
*CAS_298-46-4	Carbamazepin	298-46-4
*CAS_63-25-2	Carbaryl	63-25-2
*CAS_10605-21-7	Carbendazim	10605-21-7
*CAS_16118-49-3	Carbetamide	16118-49-3
*CAS_1563-66-2	Carbofuran	1563-66-2

ID_Contaminant	Label	CASNumber
*CAS_7440-44-0	Carbon	7440-44-0
*CAS_56-23-5	Carbon tetrachloride	56-23-5
*CAS_3812-32-6	Carbonate	3812-32-6
*CAS_786-19-6	Carbophenothion	786-19-6
*EEA_123-06-8	Charaphytes presence	
*CAS_10599-90-3	Chloramide	10599-90-3
*CAS_14866-68-3	Chlorates	14866-68-3
*CAS_13360-45-7	Chlorbromuron	13360-45-7
*CAS_57-74-9	Chlordane	57-74-9
*CAS_143-50-0	Chlordecone (Kepone)	143-50-0
*CAS_6164-98-3	Chlordimeform	6164-98-3
*CAS_470-90-6	Chlorfenvinphos	470-90-6
*CAS_7790-93-4	Chloric acid	7790-93-4
*CAS_1698-60-8	Chloridazon	1698-60-8
*CAS_6339-19-1	Chloridazon desphenyl	6339-19-1
*CAS_17254-80-7	Chloridazon methyl desphenyl	17254-80-7
*CAS_16887-00-6	Chloride	16887-00-6
*EEA_33-06-7	Chlorinated benzene	
*EEA_33-07-8	Chlorinated phenol	
*EEA_3142-02-7	Chlorine Cl-	
*CAS_14998-27-7	Chlorite	14998-27-7
*CAS_85535-84-8	Chloroalkanes C10-13	85535-84-8
*CAS_85535-85-9	Chloroalkanes C14-17,MCCP	85535-85-9
*CAS_108-90-7	Chlorobenzene	108-90-7
*CAS_75-01-4	Chloroethene (vinylchloride)	75-01-4
*EEA_3164-01-0	Chlorophyll a	
*CAS_1897-45-6	Chlorothalonil	1897-45-6
*CAS_1418095-02-9	Chlorothalonil ESA (VIS-01)	1418095-02-9
*CAS_1982-47-4	Chloroxuron	1982-47-4
*CAS_2921-88-2	Chlorpyrifos	2921-88-2
*CAS_5598-13-0	Chlorpyrifos-methyl	5598-13-0
*CAS_64902-72-3	Chlorsulfuron	64902-72-3
*CAS_1918-13-4	Chlorthiamid	1918-13-4
*CAS_15545-48-9	Chlortoluron	15545-48-9
*EEA_33-08-9	Chromium (III)	
*CAS_18540-29-9	Chromium (VI)	18540-29-9
*CAS_7440-47-3	Chromium and its compounds	7440-47-3
*CAS_1333-82-0	Chromium trioxide (CrO3)	1333-82-0
CAS_218-01-9	Chrysene	218-01-9
*CAS_156-59-2	cis-1,2-dichloroethene	156-59-2
*CAS_10061-01-5	cis-1,3-dichloropropene	10061-01-5
*CAS_81103-11-9	Clarithromycin	81103-11-9
*CAS_81777-89-1	Clomazone	81777-89-1
*CAS_1702-17-6	Clopyralid	1702-17-6
*CAS_210880-92-5	Clothianidin	210880-92-5
*CAS_23593-75-1	Clotrimazole	23593-75-1
*CAS_7440-48-4	Cobalt and its compounds	7440-48-4
*EEA_3133-03-7	CODCr	
*EEA_3133-04-8	CODMn	
*CAS_7440-50-8	Copper and its compounds	7440-50-8
*CAS_56-72-4	Coumaphos	56-72-4

ID_Contaminant	Label	CASNumber
*CAS_21725-46-2	Cyanazine	21725-46-2
*EEA_11-06-3	Cyanobacteria biomass	
*EEA_11-07-4	Cyanobacteria proportion	
*CAS_506-77-4	Cyanogen chloride	506-77-4
*CAS_28159-98-0	Cybutryne	28159-98-0
*CAS_294-62-2	Cyclododecane	294-62-2
*CAS_101205-02-1	Cycloxydim	101205-02-1
*CAS_57966-95-7	Cymoxanil	57966-95-7
*CAS_52315-07-8	Cypermethrin	52315-07-8
*CAS_121552-61-2	Cyprodinil	121552-61-2
*CAS_75-99-0	Dalapon	75-99-0
*CAS_789-02-6	DDT, o,p'	789-02-6
*CAS_50-29-3	DDT, p,p'	50-29-3
*CAS_3397-62-4	Deisopropyldeethylatrazine	3397-62-4
*CAS_319-86-8	Delta-HCH	319-86-8
*CAS_52918-63-5	Deltamethrin	52918-63-5
*CAS_919-86-8	Demeton-S-methyl	919-86-8
*CAS_17040-19-6	Demeton-S-methylsulfon	17040-19-6
*CAS_52236-30-3	Desamino-diketo-metribuzin	52236-30-3
*CAS_6190-65-4	Desethylatrazine	6190-65-4
*CAS_30125-63-4	Desethylterbuthylazine	30125-63-4
*CAS_1007-28-9	Desisopropylatrazine	1007-28-9
*CAS_13684-56-5	Desmedipham	13684-56-5
*CAS_1014-69-3	Desmetryn	1014-69-3
*EEA_33-09-0	Detergents	
*CAS_84-66-2	Di-ethyl phthalate	84-66-2
*CAS_84-69-5	Di-iso-butyl phthalate	84-69-5
*CAS_117-81-7	Di(2-ethylhexyl)phthalate (DEHP)	117-81-7
*CAS_333-41-5	Diazinon	333-41-5
*CAS_53-70-3	Dibenzo(a,h)anthracene	53-70-3
*CAS_262-12-4	Dibenzodioxin	262-12-4
*CAS_3252-43-5	Dibromoacetonitrile	3252-43-5
*CAS_124-48-1	Dibromochlorometane	124-48-1
*CAS_74-95-3	Dibromomethane	74-95-3
*CAS_84-74-2	Dibutylphthalate	84-74-2
*CAS_1002-53-5	Dibutyltin	1002-53-5
*CAS_1918-00-9	Dicamba	1918-00-9
*CAS_1194-65-6	Dichlobenil	1194-65-6
*CAS_79-43-6	Dichloroacetic acid	79-43-6
*CAS_3018-12-0	Dichloroacetonitrile	3018-12-0
*EEA_33-10-3	Dichlorobenzene	
*CAS_75-71-8	Dichlorodifluoromethane	75-71-8
*CAS_75-09-2	Dichloromethane	75-09-2
*EEA_33-11-4	Dichlorophenol	
*CAS_120-36-5	Dichlorprop (2,4-DP)	120-36-5
*CAS_15165-67-0	Dichlorprop-P	15165-67-0
*CAS_62-73-7	Dichlorvos	62-73-7
*CAS_15307-86-5	Diclofenac	15307-86-5
*CAS_15307-79-6	Diclofenac sodium	15307-79-6
*CAS_99-30-9	Dicloran	99-30-9
*CAS_115-32-2	Dicofol	115-32-2

ID_Contaminant	Label	CASNumber
*CAS_60-57-1	Dieldrin	60-57-1
*CAS_134-62-3	Diethyltoluamide (DEET)	134-62-3
*CAS_35367-38-5	Diflubenzuron	35367-38-5
*CAS_83164-33-4	Diflufenican	83164-33-4
*CAS_56507-37-0	Diketo-metribuzin	56507-37-0
*CAS_50563-36-5	Dimethachlor	50563-36-5
*CAS_87674-68-8	Dimethenamid	87674-68-8
*CAS_205939-58-8	Dimethenamid ESA	205939-58-8
*CAS_380412-59-9	Dimethenamid OA	380412-59-9
*CAS_60-51-5	Dimethoate	60-51-5
*CAS_110488-70-5	Dimethomorph	110488-70-5
*CAS_131-11-3	Dimethyl phthalate	131-11-3
*CAS_534-52-1	Dinitro-o-cresol (DNOC)	534-52-1
*CAS_88-85-7	Dinoseb	88-85-7
*CAS_2813-95-8	Dinoseb acetate	2813-95-8
*CAS_512-04-9	Diosgenin	512-04-9
EEA_33-54-5	Dioxin-like polychlorinated biphenyls (12 PCB-DLs: 77,81,105,114,118,123,126,156,157,167,169,189)	
EEA_33-58-9	Dioxins and dioxin-like compounds (7 PCDDs + 10 PCDFs + 12 PCB-DLs)	
*CAS_131-18-0	Dipentyl phthalate	131-18-0
*CAS_131-16-8	Dipropyl phthalate	131-16-8
*EEA_3133-05-9	Dissolved organic carbon (DOC)	
*EEA_3132-01-2	Dissolved oxygen	
*CAS_298-04-4	Disulfoton	298-04-4
*CAS_330-54-1	Diuron	330-54-1
*EEA_33-13-6	DOX	
*CAS_60-00-4	EDTA	60-00-4
*EEA_3142-01-6	Electrical conductivity	
*CAS_115-29-7	Endosulfan	115-29-7
*CAS_72-20-8	Endrin	72-20-8
*CAS_106-89-8	Epichlorohydrin	106-89-8
*CAS_133855-98-8	Epoxiconazole	133855-98-8
*CAS_6108-10-7	Epsilon-HCH	6108-10-7
*CAS_114-07-8	Erythromycin	114-07-8
*CAS_53-16-7	Estrone (E1)	53-16-7
*CAS_135410-20-7	Ethanimidamide	135410-20-7
*CAS_29973-13-5	Ethiofencarb	29973-13-5
*CAS_563-12-2	Ethion	563-12-2
*CAS_23947-60-6	Ethirimol	23947-60-6
*CAS_26225-79-6	Ethofumesate	26225-79-6
*CAS_2104-64-5	Ethyl O-(p-nitrophenyl) phenyl phosphonothionate (EPN)	2104-64-5
*CAS_100-41-4	Ethylbenzene	100-41-4
*CAS_75-21-8	Ethylene oxide	75-21-8
*CAS_96-45-7	Ethylenethiourea (ETU)	96-45-7
*CAS_80844-07-1	Etofenprox	80844-07-1
*EEA_33-14-7	Extractable organically bound chlorine	
*CAS_120928-09-8	Fenazaquin	120928-09-8
*CAS_13356-08-6	Fenbutatin oxide	13356-08-6
*CAS_299-84-3	Fenchlorphos	299-84-3
*CAS_122-14-5	Fenitrothion	122-14-5
*CAS_93-72-1	Fenoprop	93-72-1

ID_Contaminant	Label	CASNumber
*CAS_95617-09-7	Fenoxaprop	95617-09-7
*CAS_67564-91-4	Fenpropimorph	67564-91-4
*CAS_134098-61-6	Fenpyroximate	134098-61-6
*CAS_55-38-9	Fenthion	55-38-9
*CAS_101-42-8	Fenuron	101-42-8
*EEA_14-03-9	FishEQR_A	
*EEA_14-04-0	FishEQR_E	
*EEA_14-01-7	FishEQR_G	
*EEA_14-02-8	FishEQR_H	
*CAS_79241-46-6	Fluazifop-P-butyl	79241-46-6
*CAS_70124-77-5	Flucythrinate	70124-77-5
*CAS_142459-58-3	Flufenacet	142459-58-3
*CAS_201668-32-8	Flufenacet ESA	201668-32-8
*CAS_206-44-0	Fluoranthene	206-44-0
*CAS_86-73-7	Fluorene	86-73-7
*CAS_16984-48-8	Fluoride	16984-48-8
*CAS_7782-41-4	Fluorine	7782-41-4
*CAS_144-49-0	Fluoroacetic acid	144-49-0
*CAS_54910-89-3	Fluoxetine	54910-89-3
*CAS_136426-54-5	Fluquinconazole	136426-54-5
*CAS_69377-81-7	Fluroxypyr	69377-81-7
*CAS_81406-37-3	Fluroxypyr-meptyl	81406-37-3
*CAS_133-07-3	Folpet	133-07-3
*CAS_72178-02-0	Fomesafen	72178-02-0
*CAS_944-22-9	Fonofos	944-22-9
*CAS_50-00-0	Formaldehyde	50-00-0
*CAS_2540-82-1	Formothion	2540-82-1
*CAS_57-12-5	Free cyanide	57-12-5
*CAS_121776-33-8	Furilazole	121776-33-8
*CAS_58-89-9	Gamma-HCH (Lindane)	58-89-9
*CAS_134237-52-8	gamma-Hexabromocyclododecane	134237-52-8
*CAS_1071-83-6	Glyphosate	1071-83-6
*EEA_34-02-6	Groundwater Directive Annex II pollutant	
*EEA_33-15-8	Halogenated organic compounds	
*EEA_31-01-6	Hardness	
*EEA_32-25-7	Heavy metals - aggregated	
*CAS_76-44-8	Heptachlor	76-44-8
*EEA_33-50-1	Heptachlor and heptachlor epoxide	
*CAS_1024-57-3	Heptachlor epoxide	1024-57-3
*CAS_32241-08-0	Heptachloronaphthalene	32241-08-0
*CAS_2440-02-0	Heptachloronorbornene	2440-02-0
*CAS_36355-01-8	Hexabromobiphenyl	36355-01-8
*EEA_33-57-8	Hexabromocyclododecanes (HBCDD)	
*CAS_36483-60-0	Hexabromodiphenylether	36483-60-0
*CAS_118-74-1	Hexachlorobenzene	118-74-1
*CAS_87-68-3	Hexachlorobutadiene	87-68-3
*CAS_608-73-1	Hexachlorocyclohexane	608-73-1
*CAS_77-47-4	Hexachlorocyclopentadiene (HCCP)	77-47-4
*CAS_1335-87-1	Hexachloronaphthalene	1335-87-1
*CAS_107-46-0	Hexamethyldisiloxane (HMDS)	107-46-0
*CAS_51235-04-2	Hexazinone	51235-04-2

ID_Contaminant	Label	CASNumber
*EEA_33-17-0	Hydrocarbons	
*CAS_71-52-3	Hydrogen Carbonate (Bicarbonate) HCO3	71-52-3
*CAS_74-90-8	Hydrogen cyanide	74-90-8
*CAS_7783-06-4	Hydrogen sulphide	7783-06-4
*CAS_2163-68-0	Hydroxyatrazine	2163-68-0
*CAS_2599-11-3	Hydroxysimazine	2599-11-3
*CAS_66753-07-9	Hydroxyterbuthylazine	66753-07-9
*CAS_15687-27-1	Ibuprofen	15687-27-1
*CAS_182636-13-1	Imazamox	182636-13-1
*CAS_138261-41-3	Imidacloprid	138261-41-3
*CAS_105827-78-9	Imidacloprid (Watch list only alternative code)	105827-78-9
*CAS_193-39-5	Indeno(1,2,3-cd)pyrene	193-39-5
*EEA_32-27-9	Industrial pollutants - aggregated	
*EEA_13-03-6	InvertebrateEQR_A	
*EEA_13-04-7	InvertebrateEQR_E	
*EEA_13-01-4	InvertebrateEQR_G	
*EEA_13-02-5	InvertebrateEQR_H	
*CAS_20461-54-5	Iodide	20461-54-5
*CAS_18181-70-9	Iodofenphos	18181-70-9
*CAS_185119-76-0	Iodosulfuron-methyl	185119-76-0
*CAS_1689-83-4	Ioxynil	1689-83-4
*CAS_36734-19-7	Iprodione	36734-19-7
*CAS_140923-17-7	Iprovalicarb	140923-17-7
*CAS_7439-89-6	Iron and its compounds	7439-89-6
*CAS_297-78-9	Isobenzane	297-78-9
*CAS_465-73-6	Isodrin	465-73-6
*EEA_123-07-9	Isoetides presence	
*CAS_98-82-8	Isopropylbenzene	98-82-8
*CAS_34123-59-6	Isoproturon	34123-59-6
*CAS_141112-29-0	Isoxaflutole	141112-29-0
*CAS_4234-79-1	Kelevan	4234-79-1
*EEA_3161-01-1	Kjeldahl nitrogen	
*CAS_143390-89-0	Kresoxim-methyl	143390-89-0
CAS_7439-92-1	Lead and its compounds	7439-92-1
*CAS_2164-08-1	Lenacil	2164-08-1
*CAS_330-55-2	Linuron	330-55-2
*CAS_7439-93-2	Lithium	7439-93-2
*CAS_108-38-3	M-xylene	108-38-3
*EEA_123-05-7	Macrophyte depth limit	
*EEA_123-03-5	MacrophyteEQR_A	
*EEA_123-04-6	MacrophyteEQR_E	
*EEA_123-01-3	MacrophyteEQR_G	
*EEA_123-02-4	MacrophyteEQR_H	
*CAS_7439-95-4	Magnesium	7439-95-4
*CAS_121-75-5	Malathion	121-75-5
*CAS_123-33-1	Maleinhydrazid	123-33-1
*CAS_7439-96-5	Manganese and its compounds	7439-96-5
*CAS_94-74-6	MCPA	94-74-6
*CAS_94-81-5	MCPB	94-81-5
*CAS_7085-19-0	Mecoprop	7085-19-0
*CAS_16484-77-8	Mecoprop-P (MCPP-P)	16484-77-8

ID_Contaminant	Label	CASNumber
CAS_7439-97-6	Mercury and its compounds	7439-97-6
*CAS_104206-82-8	Mesotrione	104206-82-8
*EEA_33-18-1	Meta xylene + para xylene	
*CAS_57837-19-1	Metalaxyl	57837-19-1
*CAS_70630-17-0	Metalaxyl-M	70630-17-0
*CAS_41394-05-2	Metamitron	41394-05-2
*CAS_67129-08-2	Metazachlor	67129-08-2
*CAS_172960-62-2	Metazachlor ESA	172960-62-2
*CAS_1231244-60-2	Metazachlor OA	1231244-60-2
*CAS_18691-97-9	Methabenzthiazuron	18691-97-9
*CAS_10265-92-6	Methamidophos	10265-92-6
*CAS_950-37-8	Methidathion	950-37-8
*CAS_2032-65-7	Methiocarb	2032-65-7
*CAS_16752-77-5	Methomyl	16752-77-5
*CAS_72-43-5	Methoxychlor	72-43-5
*CAS_136-85-6	Methylbenzotriazol	136-85-6
*CAS_3060-89-7	Metobromuron	3060-89-7
*CAS_51218-45-2	Metolachlor	51218-45-2
*CAS_171118-09-5	Metolachlor ESA	171118-09-5
*CAS_152019-73-3	Metolachlor OA	152019-73-3
*CAS_37350-58-6	Metoprolol	37350-58-6
*CAS_139528-85-1	Metosulam	139528-85-1
*CAS_19937-59-8	Metoxuron	19937-59-8
*CAS_21087-64-9	Metribuzin	21087-64-9
*CAS_35045-02-4	Metribuzin-DA	35045-02-4
*CAS_74223-64-6	Metsulfuronmethyl	74223-64-6
*CAS_7786-34-7	Mevinphos	7786-34-7
*CAS_77238-39-2	Microcystin	77238-39-2
*CAS_2385-85-5	Mirex	2385-85-5
*CAS_2212-67-1	Molinate	2212-67-1
*CAS_7439-98-7	Molybdenum and its compounds	7439-98-7
*EEA_33-19-2	Mono basic phenols	
*EEA_33-20-5	Monochlorophenols	
*CAS_1746-81-2	Monolinuron	1746-81-2
*CAS_150-68-5	Monuron	150-68-5
*CAS_4636-83-3	Morfamquat	4636-83-3
*CAS_1634-04-4	MTBE	1634-04-4
*CAS_81-15-2	Musk xylene	81-15-2
*CAS_104-51-8	n-butylbenzene	104-51-8
*CAS_4245-76-5	N-methyl-N'-nitroguanidine	4245-76-5
*CAS_103-65-1	n-propylbenzene	103-65-1
*CAS_3984-14-3	N,N-dimethylsulfamide	3984-14-3
*CAS_91-20-3	Naphthalene	91-20-3
*CAS_70776-03-3	Naphthalene, chloro derivatives	70776-03-3
*CAS_15299-99-7	Napropamide	15299-99-7
*CAS_22204-53-1	Naproxen	22204-53-1
*CAS_555-37-3	Neburon	555-37-3
*CAS_7440-02-0	Nickel and its compounds	7440-02-0
*CAS_111991-09-4	Nicosulfuron	111991-09-4
*CAS_14797-55-8	Nitrate	14797-55-8
*EEA_3164-08-7	Nitrate to orthophosphate ratio	

ID_Contaminant	Label	CASNumber
*CAS_14797-65-0	Nitrite	14797-65-0
*EEA_33-21-6	Nitrobenzene	
*CAS_556-88-7	Nitroguanidine	556-88-7
*CAS_1836-75-5	Nitrophen	1836-75-5
*CAS_100-02-7	Nitrophenol	100-02-7
*EEA_31613-01-1	Non-ionised ammonia	
*EEA_33-59-0	Nonylphenol and nonylphenol ethoxylates (NP + NPEs)	
*CAS_9016-45-9	Nonylphenol ethoxylate	9016-45-9
*CAS_139-13-9	NTA	139-13-9
*CAS_95-47-6	O-xylene	95-47-6
*CAS_53-19-0	o,p'-DDD	53-19-0
*CAS_3424-82-6	o,p'-DDE	3424-82-6
*CAS_32536-52-0	Octabromodiphenyl ether	32536-52-0
*CAS_2234-13-1	Octachloronaphthalene	2234-13-1
*CAS_1806-26-4	Octylphenol	1806-26-4
*CAS_140-66-9	Octylphenol (4-(1,1',3,3'-tetramethylbutyl)-phenol)	140-66-9
*EEA_33-55-6	Octylphenols (CAS 1806-26-4) including isomer 4-(1,1',3,3'-tetramethylbutyl)-phenol (CAS 140-66-9)	
*EEA_33-22-7	Oil fractions (C10-40)	
*CAS_1113-02-6	Omethoate	1113-02-6
*CAS_34622-58-7	Orbencarb	34622-58-7
*EEA_33-60-3	Organotin compounds (as total Sn)	
*EEA_00-00-0	Other chemical parameter	
*EEA_34-03-7	Other pollutants - aggregated	
*CAS_19666-30-9	Oxadiazon	19666-30-9
*CAS_23135-22-0	Oxamyl	23135-22-0
*EEA_3131-01-9	Oxygen saturation	
*CAS_79-57-2	Oxytetracycline	79-57-2
*CAS_106-42-3	P-xylene	106-42-3
*CAS_72-54-8	p,p'-DDD	72-54-8
*CAS_72-55-9	p,p'-DDE	72-55-9
*CAS_56-38-2	Parathion	56-38-2
*CAS_298-00-0	Parathion-methyl	298-00-0
*EEA_3161-04-4	Particulate organic nitrogen	
CAS_37680-73-2	PCB 101 (2,2’,4,5,5’-pentachlorobiphenyl)	37680-73-2
*CAS_60145-21-3	PCB 103 (2,2',4,5',6-pentachlorobiphenyl)	60145-21-3
*CAS_32598-14-4	PCB 105 (2,3,3’,4,4’-pentachlorobiphenyl)	32598-14-4
*CAS_70362-41-3	PCB 106 (2,3,3',4,5'-pentachlorobiphenyl)	70362-41-3
*CAS_74472-37-0	PCB 114 (2,3,4,4',5-pentachlorobiphenyl)	74472-37-0
*CAS_31508-00-6	PCB 118 (2,3’,4,4’,5-pentachlorobiphenyl)	31508-00-6
*CAS_65510-44-3	PCB 123 (1,2,3-trichloro-5-(2,4-dichlorophenyl)benzene)	65510-44-3
*CAS_57465-28-8	PCB 126 (3,3’,4,4’,5-pentachlorobiphenyl)	57465-28-8
CAS_35065-28-2	PCB 138 (2,2’,3,4,4’,5’-hexachlorobiphenyl)	35065-28-2
CAS_35065-27-1	PCB 153 (2,2’,4,4’,5,5’-hexachlorobiphenyl)	35065-27-1
*CAS_38380-08-4	PCB 156 (2,3,3’,4,4’,5-hexachlorobiphenyl)	38380-08-4
*CAS_69782-90-7	PCB 157 (2,3,3’,4,4’,5’-hexachlorobiphenyl)	69782-90-7
*CAS_52663-72-6	PCB 167 (1,2,3-trichloro-5-(2,4,5-trichlorophenyl)benzene)	52663-72-6
*CAS_32774-16-6	PCB 169 (3,3’,4,4’,5,5’-hexachlorobiphenyl)	32774-16-6
*CAS_35065-30-6	PCB 170 (1,2,3,4-tetrachloro-5-(2,3,4-trichlorophenyl)benzene)	35065-30-6
CAS_35065-29-3	PCB 180 (2,2’,3,4,4’,5,5’-heptachlorobiphenyl)	35065-29-3

ID_Contaminant	Label	CASNumber
*CAS_39635-31-9	PCB 189 (1,2,3,4-tetrachloro-5-(3,4,5-trichlorophenyl)benzene)	39635-31-9
*CAS_35694-08-7	PCB 194 (1,2,3,4-tetrachloro-5-(2,3,4,5-tetrachlorophenyl)benzene)	35694-08-7
*CAS_2051-24-3	PCB 209 (5,5’,6,6’-decachlorobiphenyl)	2051-24-3
CAS_7012-37-5	PCB 28 (2,4,4’-trichlorobiphenyl)	7012-37-5
CAS_35693-99-3	PCB 52 (2,2’,5,5’-tetrachlorobiphenyl)	35693-99-3
*CAS_41464-42-0	PCB 72 (2,3',5,5'-Tetrachlorobiphenyl)	41464-42-0
*CAS_32598-13-3	PCB 77 (3,3’,4,4’-tetrachlorobiphenyl)	32598-13-3
*CAS_70362-50-4	PCB 81 (3,4,4',5-tetrachlorobiphenyl)	70362-50-4
*CAS_66246-88-6	Penconazole	66246-88-6
*CAS_40487-42-1	Pendimethalin	40487-42-1
*CAS_32534-81-9	Pentabromodiphenylether	32534-81-9
*CAS_85-22-3	Pentabromoethylbenzene	85-22-3
*CAS_1825-21-4	Pentachloroanisole	1825-21-4
*CAS_608-93-5	Pentachlorobenzene	608-93-5
*CAS_16478-18-5	Pentachloroiodobenzene	16478-18-5
*CAS_1321-64-8	Pentachloronaphthalene	1321-64-8
*CAS_87-86-5	Pentachlorophenol	87-86-5
*CAS_1763-23-1	Perfluorooctane sulfonic acid (PFOS) and its derivatives	1763-23-1
*CAS_52645-53-1	Permethrin-cis+trans	52645-53-1
*EEA_32-26-8	Pesticides - aggregated	
*EEA_34-01-5	Pesticides (Active substances in pesticides, including their relevant metabolites, degradation and reaction products)	
*CAS_106700-29-2	Pethoxamid	106700-29-2
*EEA_33-23-8	Petroleum hydrocarbons	
*EEA_33-24-9	Petroleum products	
*CAS_335-67-1	PFOA	335-67-1
*EEA_3152-01-0	pH	
*CAS_85-01-8	Phenanthrene	85-01-8
*CAS_108-95-2	Phenol	108-95-2
*CAS_64743-03-9	Phenols	64743-03-9
*CAS_298-02-2	Phorate	298-02-2
*CAS_2310-17-0	Phosalone	2310-17-0
*CAS_14265-44-2	Phosphate	14265-44-2
*EEA_124-03-8	PhytobenthosEQR_A	
*EEA_124-04-9	PhytobenthosEQR_E	
*EEA_124-01-6	PhytobenthosEQR_G	
*EEA_124-02-7	PhytobenthosEQR_H	
*EEA_11-03-0	PhytoplanktonEQR_A	
*EEA_11-04-1	PhytoplanktonEQR_E	
*EEA_11-01-8	PhytoplanktonEQR_G	
*EEA_11-02-9	PhytoplanktonEQR_H	
*CAS_1918-02-1	Picloram	1918-02-1
*CAS_137641-05-5	Picolinafen	137641-05-5
*CAS_23103-98-2	Pirimicarb	23103-98-2
*CAS_23505-41-1	Pirimiphos-ethyl	23505-41-1
*CAS_29232-93-7	Pirimiphos-methyl	29232-93-7
*CAS_1336-36-3	Polychlorinated biphenyls	1336-36-3
EEA_33-38-5	Polychlorinated biphenyls(7 PCB: 28,52,101,118,138,153,180)	
*EEA_33-26-1	Polychlorinated dibenzodioxins (PCDD)	

ID_Contaminant	Label	CASNumber
*CAS_136677-10-6	Polychlorinated dibenzofurans (10 PCDFs)	136677-10-6
*CAS_7440-09-7	Potassium	7440-09-7
*CAS_86209-51-0	Primisulfuron-methyl	86209-51-0
*CAS_67747-09-5	Prochloraz	67747-09-5
*CAS_32809-16-8	Procymidone	32809-16-8
*CAS_1610-18-0	Prometon	1610-18-0
*CAS_7287-19-6	Prometryn	7287-19-6
*CAS_1918-16-7	Propachlor	1918-16-7
*CAS_709-98-8	Propanil	709-98-8
*CAS_139-40-2	Propazine	139-40-2
*CAS_31218-83-4	Propetamphos	31218-83-4
*CAS_60207-90-1	Propiconazole	60207-90-1
*CAS_114-26-1	Propoxur	114-26-1
*CAS_525-66-6	Propranolol	525-66-6
*CAS_23950-58-5	Propyzamide	23950-58-5
*CAS_52888-80-9	Prosulfocarb	52888-80-9
*CAS_94125-34-5	Prosulfuron	94125-34-5
*CAS_129-00-0	Pyrene	129-00-0
*CAS_96489-71-3	Pyridaben	96489-71-3
*CAS_55512-33-9	Pyridate	55512-33-9
*CAS_53112-28-0	Pyrimethanil	53112-28-0
*CAS_124495-18-7	Quinoxyfen	124495-18-7
*CAS_82-68-8	Quintozene	82-68-8
*CAS_76578-12-6	Quizalofop	76578-12-6
*CAS_100646-51-3	Quizalofop-P-ethyl	100646-51-3
EEA_33-27-2	Radionuclides	
*CAS_122931-48-0	Rimsulfuron	122931-48-0
*CAS_7286-69-3	Sebuthylazine	7286-69-3
*CAS_135-98-8	sec-butylbenzene	135-98-8
*CAS_26259-45-0	Secbumeton	26259-45-0
*EEA_3111-01-1	Secchi depth	
*CAS_7782-49-2	Selenium and its compounds	7782-49-2
*EEA_3163-01-7	Silicate	
*CAS_7440-21-3	Silicon	7440-21-3
*CAS_7440-22-4	Silver	7440-22-4
*CAS_122-34-9	Simazine	122-34-9
*CAS_7440-23-5	Sodium	7440-23-5
*CAS_151-21-3	Sodium dodecyl sulfate	151-21-3
*CAS_118134-30-8	Spiroxamine	118134-30-8
*CAS_7440-24-6	Strontium	7440-24-6
*CAS_100-42-5	Styrene	100-42-5
*CAS_99105-77-8	Sulcotrione	99105-77-8
*CAS_723-46-6	Sulfamethoxazol	723-46-6
*CAS_141776-32-1	Sulfosulfuron	141776-32-1
*CAS_18785-72-3	Sulphate	18785-72-3
*EEA_33-28-3	Surfactants (anionic and nonionic)	
*EEA_33-29-4	Surfactants (anionic)	
*CAS_994-05-8	TAME	994-05-8
*CAS_1746-01-6	TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin)	1746-01-6
*CAS_107534-96-3	Tebuconazole	107534-96-3
*CAS_112410-23-8	Tebufenozide	112410-23-8

ID_Contaminant	Label	CASNumber
*CAS_13071-79-9	Terbufos	13071-79-9
*CAS_33693-04-8	Terbumeton	33693-04-8
*CAS_5915-41-3	Terbuthylazine	5915-41-3
*CAS_886-50-0	Terbutryn	886-50-0
*CAS_98-06-6	tert-butylbenzene	98-06-6
*CAS_79-94-7	Tetrabromobisphenol A (TBBP-A)	79-94-7
*CAS_40088-47-9	Tetrabromodiphenylether	40088-47-9
*CAS_1461-25-2	Tetrabutyltin	1461-25-2
*CAS_127-18-4	Tetrachloroethylene	127-18-4
*CAS_1335-88-2	Tetrachloronaphthalene	1335-88-2
*CAS_25167-83-3	Tetrachlorophenols	25167-83-3
*CAS_2227-13-6	Tetrasul	2227-13-6
*CAS_7440-28-0	Thallium	7440-28-0
*CAS_111988-49-9	Thiacloprid	111988-49-9
*CAS_153719-23-4	Thiamethoxam	153719-23-4
*CAS_79277-27-3	Thifensulfuron-methyl	79277-27-3
*CAS_28249-77-6	Thiobencarb	28249-77-6
*CAS_23564-05-8	Thiophanate-methyl	23564-05-8
*CAS_137-26-8	Thiram	137-26-8
*CAS_7440-31-5	Tin and its compounds	7440-31-5
*CAS_36756-79-3	Tiocarbazil	36756-79-3
*CAS_7440-32-6	Titanium	7440-32-6
*CAS_108-88-3	Toluene	108-88-3
*CAS_13351-73-0	Tolyltriazole	13351-73-0
*EEA_32-23-5	Total Benzo(b)fluor-anthene (CAS_205-99-2) + Benzo(k)fluor-anthene (CAS_207-08-9)	
*EEA_32-24-6	Total Benzo(g,h,i)perylene (CAS_191-24-2) + Indeno(1,2,3-cd)pyrene (CAS_193-39-5)	
*EEA_33-63-6	Total brominated diphenylethers (penta-BDE + octa-BDE + deca-BDE)	
*EEA_33-31-8	Total chrysene + triphenylene	
*EEA_33-64-7	Total cyanide	
*EEA_32-02-0	Total cyclodiene pesticides (aldrin + dieldrin + endrin + isodrin)	
*EEA_33-32-9	Total DDD (DDD, o,p' + DDD, p,p')	
*EEA_32-03-1	Total DDT (DDT, p,p' + DDT, o,p' + DDE, p,p' + DDD, p,p')	
EEA_33-40-9	Total dioxins and furans (PCDD + PCDF)	
*EEA_31-03-8	Total dissolved solids	
*EEA_33-53-4	Total Estrone (E1) + 17beta-estradiol (E2)	
*EEA_33-44-3	Total highly volatile halogenated hydrocarbons	
*EEA_33-36-3	Total hydrocarbons	
*EEA_3161-05-5	Total inorganic nitrogen	
*EEA_33-51-2	Total macrolide antibiotics (erythromycin + clarithromycin + azithromycin)	
*EEA_33-52-3	Total neonicotinoid insecticides (imidacloprid + thiacloprid + thiamethoxam + clothianidin + acetamiprid)	
*EEA_31615-01-7	Total nitrogen	
*EEA_3164-07-6	Total nitrogen to total phosphorus ratio	
*EEA_3133-06-0	Total organic carbon (TOC)	
*EEA_3161-03-3	Total organic nitrogen	
*EEA_3161-02-2	Total oxidised nitrogen	
EEA_33-62-5	Total PAHs (4 PAHs: Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene)	

ID_Contaminant	Label	CASNumber
EEA_33-56-7	Total PAHs (Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(ghi)perylene, Indeno(1,2,3-cd)pyrene)	
*CAS_7723-14-0	Total phosphorus	7723-14-0
*EEA_11-05-2	Total phytoplankton biomass	
*EEA_31-02-7	Total suspended solids	
*EEA_33-41-0	Total tri-, tetra- and pentachlorophenol	
*EEA_33-42-1	Total trichloroethylene + tetrachloroethylene	
*EEA_33-43-2	Total trihalomethanes	
*CAS_8001-35-2	Toxaphene	8001-35-2
*CAS_87820-88-0	Tralkoxydim	87820-88-0
*CAS_156-60-5	trans-1,2-dichloroethene	156-60-5
*CAS_10061-02-6	trans-1,3-dichloropropene	10061-02-6
*CAS_39765-80-5	trans-Nonachlor	39765-80-5
*CAS_2303-17-5	Tri-allate	2303-17-5
*CAS_43121-43-3	Triadimefon	43121-43-3
*CAS_55219-65-3	Triadimenol	55219-65-3
*CAS_82097-50-5	Triasulfuron	82097-50-5
*CAS_24017-47-8	Triazophos	24017-47-8
*CAS_36643-28-4	Tributyltin-cation	36643-28-4
*CAS_76-03-9	Trichloroacetic acid	76-03-9
*CAS_12002-48-1	Trichlorobenzenes (all isomers)	12002-48-1
*CAS_79-01-6	Trichloroethylene	79-01-6
*CAS_75-69-4	Trichlorofluoromethane	75-69-4
*CAS_67-66-3	Trichloromethane	67-66-3
*CAS_1321-65-9	Trichloronaphthalene	1321-65-9
*CAS_55335-06-3	Triclopyr	55335-06-3
*CAS_3380-34-5	Triclosan	3380-34-5
*CAS_1912-26-1	Trietazine	1912-26-1
*CAS_1582-09-8	Trifluralin	1582-09-8
*CAS_126535-15-7	Triflusulfuron-methyl	126535-15-7
*CAS_738-70-5	Trimethoprim	738-70-5
*CAS_603-35-0	Triphenyl phosphine	603-35-0
*EEA_33-61-4	Triphenyltin and compounds	
*CAS_10028-17-8	Tritium	10028-17-8
*CAS_7440-33-7	Tungsten and its compounds	7440-33-7
*EEA_3112-01-4	Turbidity	
*CAS_7440-61-1	Uranium	7440-61-1
*CAS_7440-62-2	Vanadium and its compounds	7440-62-2
*CAS_50471-44-8	Vinclozolin	50471-44-8
*CAS_51000-52-3	Vinyl neodecanoate	51000-52-3
*EEA_33-45-4	Volatile halogenated hydrocarbons (VHH)	
*EEA_33-46-5	Volatile organic halogens (VOX)	
*EEA_3121-01-5	Water temperature	
*CAS_1330-20-7	Xylene	1330-20-7
*CAS_7440-66-6	Zinc and its compounds	7440-66-6
*CAS_137-30-4	Ziram	137-30-4

* non-mandatory under IMAP Guidance Factsheets

Table 4: DSs & DDs Module PSF1 (Levels of contaminants in seafood) for CI 20: List of species

ID_Species	Label
Alosa spp	125715
Argyrosomus regius	127007
Aristeus antennatus	107083
Auxis rokei	127015
Boops boops	127047
Brevoortia pectinata	275501
Dicentrarchus labrax	126975
Engraulis encrasicolus	126426
Epinephelus spp	126068
Loligo vulgaris	140271
Lophius piscatorius	126555
Merluccius merluccius	126484
Micromesistius poutassou	126439
Mugil cephalus	126983
Mullus barbatus	126985
Mullus spp.	126034
Mullus surmuletus	126986
Mytilus galloprovincialis	140481
Nephrops norvegicus	107254
Octopus vulgaris	140605
Pagellus bogaraveo	127059
Pagellus erythrinus	127060
Pagrus pagrus	127063
Parapenaeus longirostris	107109
Penaeus kerathurus	246388
Ruditapes decussates	231749
Ruditapes philippinarum	231750
Sarda sarda	127021
Sardina pilchardus	126421
Sardinella aurita	126422
Sardinella spp	125721
Scomber japonicus	127022
Scomber scombrus	127023
Scomber spp	126063
Scomberesox saurus	126392
Sepia officinalis	141444
Sparus aurata	151523
Sphyraena spp	126084
Spicara spp	125949
Squilla mantis	136137
Thunnus thynnus	127029
Trachurus mediterraneus	126820
Trachurus spp	125946
Trachurus trachurus	126822
Xiphias gladius	127094

Table 5: DSs & DDs **Module PSF1** (Levels of contaminants in seafood) for CI 20: **List of GSA**

Value	Description
1	Northern Alboran Sea
2	Alboran Island

Value	Description
3	Southern Alboran Sea
4	Algeria
5	Balearic Islands
6	Northern Spain
7	Gulf of Lion
8	Corsica
9	Ligurian Sea and Northern Tyrrhenian Sea
10	Southern and Central Tyrrhenian Sea
11.1	Western Sardinia
11.2	Eastern Sardinia
12	Northern Tunisia
13	Gulf of Hammamet
14	Gulf of Gabes
15	Malta
16	Southern Sicily
17	Northern Adriatic Sea
18	Southern Adriatic Sea
19	Western Ionian Sea
20	Eastern Ionian Sea
21	Southern Ionian Sea
22	Aegean Sea
23	Crete
24	Northern Levant Sea
25	Cyprus
26	Southern Levant Sea
27	Eastern Levant Sea
28	Marmara Sea
29	Black Sea
30	Azov Sea

Annex I

The concentration limits for the regulated contaminants in the EU used for preparation of Data Standards and Data Dictionaries for IMAP Common Indicator 20

The elements of Data Standards (DS) and Data Dictionaries (DDs) specific for CI 20 are based on the concentration limits for the contaminants regulated in the EU, as defined in EU Commission Regulations (EC) No 1881/2006[3], (EC) No 835/2011[4] and EC No 1259/2011[5].

Maximum Levels of Heavy Metals – (EC) Regulation 1881/2006

	Foodstuffs	Maximum levels mg kg^{-1} wet weight		
		Cadmium	Lead	Mercury
1	Muscle meat of fish (1)	0.050 Excluding species listed in 2 and 3	0.30	0.50 Excluding species listed in 4
2	Muscle meat of the following fish (1) anchovy (*Engraulis species*) bonito (*Sarda sarda*) common two-banded seabream (*Diplodus vulgaris*) eel (*Anguilla anguilla*) grey mullet (*Mugil labrosus labrosus*) horse mackerel or scad (*Trachurus species*) louvar or luvar (*Luvarus imperialis*) sardine (*Sardina pilchardus*) sardinops (*Sardinops species*) tuna (*Thunnus species, Euthynnus species, Katsuwonus pelamis*) wedge sole (*Dicologoglossa cuneata*)	0.10		
3	Muscle meat of swordfish (*Xiphias gladius*) (1)	0.30		
4	Muscle meat of the following fish: anglerfish (*Lophius species*) atlantic catfish (*Anarhichas lupus*) bonito (*Sarda sarda*) eel (*Anguilla species*) emperor, orange roughy, rosy soldierfish (*Hoplostethus species*) grenadier (*Coryphaenoides rupestris*)			1.0

[3] Commission Regulation (EC) No 1881/2006, setting maximum levels for certain contaminants in seafood
[4] Commission Regulation (EC) No 835/2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for polycyclic aromatic hydrocarbons in foodstuffs;
[5] Commission Regulation (EC) No 1259/2011, amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non-dioxin-like PCBs in foodstuffs

	halibut (*Hippoglossus hippoglossus*) marlin (*Makaira species*) megrim (*Lepidorhombus species*) mullet (*Mullus species*) pike (*Esox lucius*) plain bonito (*Orcynopsis unicolor*) poor cod (*Tricopterus minutes*) portuguese dogfish (*Centroscymnus coelolepis*) rays (*Raja species*) redfish (*Sebastes marinus, S. mentella, S. viviparus*) sail fish (*Istiophorus platypterus*) scabbard fish (*Lepidopus caudatus, Aphanopus carbo*) seabream, pandora (*Pagellus species*) shark (all species) snake mackerel or butterfish (*Lepidocybium flavobrunneum, Ruvettus pretiosus, Gempylus serpens*) sturgeon (*Acipenser species*) swordfish (*Xiphias gladius*) tuna (*Thunnus species, Euthynnus species, Katsuwonus pelamis*)			
5	Crustaceans, excluding brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans	0.50	0.50	0.50
6	Bivalve molluscs	1.0	1.5	
7	Cephalopods (without viscera)	1.0	1.0	

(1) Exclusion of liver. Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish

Maximum Levels ofBenzo(a)pyrene and sum of four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluorantheneand chrysene) Regulation No 835/2011 amending Regulation (EC) 1881/2006

Foodstuffs	Maximum levels (µg kg^{-1})	
	Benzo(a)pyrene	Sum of benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene *
Bivalve molluscs (fresh, chilled or frozen)	5.0	30.0

* Lower bound concentrations are calculated on the assumption that all the values of thefour substances below the limit of quantification are zero

Maximum Levels of Dioxins and PCBs - Regulation (EC) 1259/2011 amending Regulation (EC) 1881/2006

Foodstuffs	Maximum levels		
	Sum of dioxins (WHO-PCDD/F-TEQ) (1)	Sum of dioxins and dioxin-like PCBS (WHO-PCDD/F-PCB-TEQ) (1)	Sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 (ICES 6)
Muscle meat of fish and fishery products and products thereof (2) with the exemption of: • wild caught eel • wild caught fresh water fish, with the exception of diadromous fish species caught in fresh water • fish liver and derived products • marine oils The maximum level for crustaceans applies to muscle meat from appendages and abdomen. In case of crabs and crab-like crustaceans (*Brachyura and Anomura*) it applies to muscle meat from appendages.	3.5 pg g^{-1} wet weight	6.5 pg g^{-1} wet weight	75 ng g^{-1} wet weight

(1) Dioxins (sum of polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), expressed as World Health Organisation (WHO) toxic equivalent usingthe WHO-toxic equivalency factors (WHO-TEFs)) and sum of dioxins and dioxin-like PCBs (sum of PCDDs, PCDFs and polychlorinated biphenyls (PCBs), expressed as WHO toxic equivalent using the WHO-TEFs). WHO-TEFs for human risk assessment based on the conclusions of the World Health Organization (WHO) (For TEF values see note 31, (EC) Regulation 1259/2011 – Annex 1.1.9.).

(2) Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish.

Appendix 7

Initial Results of Marine Environment Assessment for IMAP Common Indicator 21

1. Introduction

1. Updated Guidance Fact sheet for IMAP CI 21[1] 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)[2]. 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.

2. 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 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".

3. The COP 17[3] agreed on the threshold values in the Mediterranean region as presented in Table 1. 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 proposed to be defined as in GES while category D is proposed to be defined as non-GES for intestinal enterococci (IE) in bathing waters in the Mediterranean.

Table 1. 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 95^{th} percentile; ** Based on the 90^{th} 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).

4. For the indicator calculation, the IMAP Guidance fact sheet for CI 21 provides the methodology that has been proposed by Directive 2006/7/EC with the specification as explained here below.

5. Based upon percentile evaluation of the log10 normal probability density function of microbiological data acquired from the particular bathing water, the 90^{th} and 95^{th}percentile values are derived as follows[4]:

i. Take the log10 value of all bacterial enumerations in the data sequence to be evaluated; If a zero value is obtained, take the log10 value of the minimum detection limit of the analytical method used instead;

[1] UNEP/MED WG.473/7 Annex I
[2] IMAP Guidance Fact Sheet for IMAP CI 21 (UNEP/MED WG.473/7)
[3] 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)
[4] UNEP/MED WG473/7 Annex I

ii. Calculate the arithmetic mean of the log10 values (μ);
iii. Calculate the standard deviation of the log10 values (σ).

6. The upper 90-percentile point of the data probability density function is derived from the following equation: upper 90-percentile = antilog (μ + 1,282 σ).

7. The upper 95-percentile point of the data probability density function is derived from the following equation: upper 95-percentile = antilog (μ + 1,65 σ).

8. It should also be noted that IMAP Guidance fact sheet for CI 21 sets the minimum sampling frequency i.e. at least one per month and not less than four in a bathing period, including an initial one prior to the start of the bathing period.

2. The assessment related to IMAP CI 21 provided in the MED QSR 2017(https://www.medqsr.org/background-ci21)

9. The previously explained assessment methodology of IMAP CI 21 was considered for application during the preparation of the 2017 Mediterranean Quality Status Report (2017 MED QSR). At that time, no sufficient updated datasets were available, therefore the assessment was undertaken 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 MEDPOL (2014).

10. 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 2.

Table 2. Available data for IMAP CI 21 in IMAP-IS starting from 2015.

Source	IMAP file	Country	Sub-region	Year
IMAP-IS	403	Morocco	WMS	2018
IMAP-IS	404	Morocco	WMS	2019
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	#	Montenegro	ADR	2017-2021
IMAP-IS	146	Slovenia	ADR	2019
IMAP-IS	440	Slovenia	ADR	2020
IMAP-IS	490*	Malta	CEN	2016-2020
IMAP-IS	147	Lebanon	AEL	2019

Reported directly to MEDPOL, still to be uploaded in the IMAP-IS, *data available in draft status

3. Location of sampling stations

11. Given lack of data reported by the CPs prevents implementation of the recommendations of COP 19, the input for the 2023 Mediterranean Quality Status Report (2023 MED QSR) related to the assessment of IMAP CI 21 was performed using the approach applied for the 2017 MED QSR. Namely, it combines the assessment results as presented in the assessment report[5] from the European Environment Agency (EEA) on the State of Bathing Water Quality in 2020[6] and the assessment of monitoring data reported for IMAP CI 21 from Morocco, Bosnia- and Herzegovina, Montenegro and Lebanon (Table 3).

Table 3. Details of data on CI 21 available from IMAP_IS used in this assessment

Source	IMAP file	Country	Sub-region	Year	Number stations	Number of data points per station
IMAP-IS	403-404	Morocco	WMS	2018-2019	130	10*
IMAP-IS	262	Bosnia- and Herzegovina	ADR	2017-2020	3	9,10,13
IMAP-IS	#	Montenegro	ADR	2017-2020	23	30-39
IMAP-IS	147	Lebanon	AEL	2019	62	1-3

Reported directly to MEDPOL, still to be uploaded in the IMAP-IS, *9 stations with less than 10 data points.

12. 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 90th or 95th 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[7], at least 4 for each bathing season. 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[8]. For example, if status for IE is excellent but for E. coli the status is poor, the station is classified as poor.

13. The same methodology used in the EEA 2020 of the state of bathing water quality was applied to the data set from Montenegro, using just intestinal enterococci as indicator.

14. This methodology could not be applied to data from Morocco, Bosnia and -Herzegovina and Lebanon because 16 data points for 4 consecutive bathing seasons were not available (Table 3). Therefore, for these 3 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 4 compares between the two methodologies.

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[5] https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/state-of-bathing-water/state-of-bathing-waters-in-2020
[6] 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.
[7] 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).
[8] EEA Guidelines for the assessment under the Bathing Water Directive Prepared by: ETC/ICM (Lidija Globevnik, Luka Snoj, Gašper Šubelj), October 2021

Table 4: 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

* Morocco, Bosnia and Herzegovina and Lebanon. Montenegro was classified using the same methodology as the EEA, therefore 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.

4. The assessment findings related to IMAP CI 21 and Discussion

15. The results of the assessment of the state of bathing water quality for Mediterranean countries, EU Member States and Albania are presented in Figure 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.

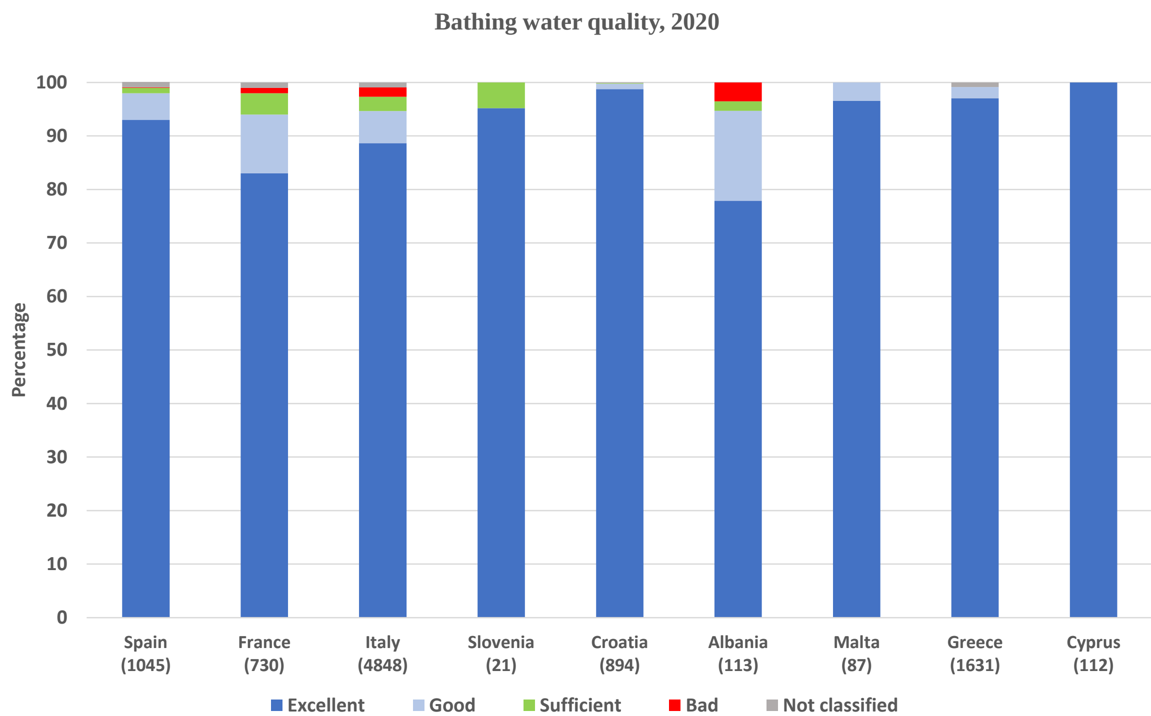

Figure 1: Percentages of the bathing water quality assessment with respect to IMAP CI 21 in 2020 for some Contracting Parties of the Barcelona Convention. (Source: EEA, 2020). In parenthesis, number of stations.

16. The results of the assessment of the status of bathing water quality for Montenegro and for Morocco, Bosnia and -Herzegovina and Lebanon performed with data available from IMAP-IS are presented in Figures 2 and 3, respectively.

17. **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 as excellent category and 2 as good category.

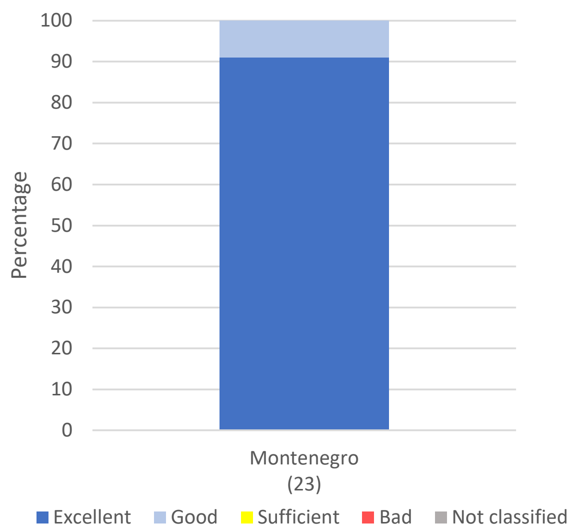

Figure 2: Percentages of the bathing water quality assessment with respect to IMAP CI 21 in 2020 for Montenegro (Source IMAP InfoSystem). In parenthesis, number of stations.

18. **Morocco:** Data were available for 130 stations for the years 2018-2019 (Table 3). All of the stations were classified as excellent category.

19. **Bosnia and- Herzegovina:** Data was available for 3 stations for the years 2017-2019 (Table 3). All 3 available stations were classified as excellent category.

20. **Lebanon:** Data was available for 62 stations for 2019 (Table 3). Out of the 62 available stations, 53 stations (85%) were classified as excellent category, 1 station (2%) as sufficient category and 8 stations (13%) as bad category. It should be mentioned that 4 out of the 8 bad category stations had only one data point.

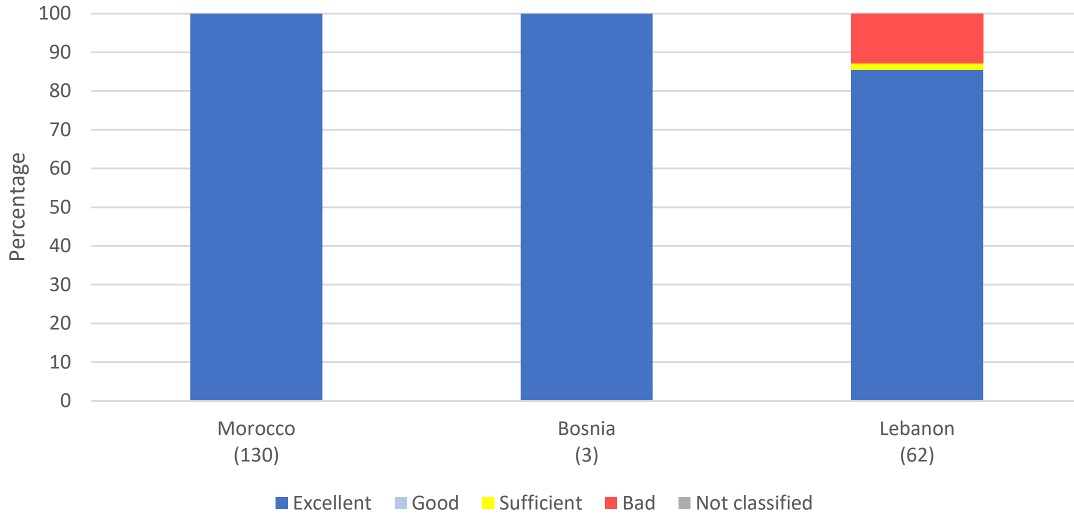

Figure 3: Percentages of the bathing water quality assessment categories with respect to IAMP CI 21 for Morocco, Bosnia and - Herzegovina, and Lebanon. (Source: IMAP InfoSystem). In parenthesis, number of stations.

5. The key findings

21. In line with the findings on the status of bathing water, as provided above in Section 4, based on the available data, the Mediterranean bathing waters can be classified in GES (excellent, good and sufficient status) whereby percentage are higher than 87% for the CPs for which the assessment was undertaken. 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.

22. The sub-regions with good representation were 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 (partial), 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 and Lebanon (partial).

23. Most of the data were available through EEA and not through IMAP IS. It must be noted that the lack of data reporting for IMAP CI 21 into IMAP IS is a key obstacle to undertaking 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/ areas 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 taken into account, especially in the case of the countries that have established monitoring programs for CI 21 and regularly implement them.

24. 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.

25. Compared to the 2017 MED QSR, the current assessment includes four CPs instead of one CP 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.

Annex I

References

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