UNITED NATIONS

UNEP

EP

UNEP/MED WG.556/Inf.14

United Nations
Environment Programme
Mediterranean Action Plan

Distr.: General
17 February 2023

Original: English only

Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring

Athens, Greece, 1-2 March 2023

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

# The Comparison of the Assessment Findings for IMAP Common Indicator 17 in the Adriatic Sea Sub-region Generated by the Application of the NEAT GES and the CHASE+ Environmental Assessment Methodologies



UNEP/MAP
Athens, 2023

**Disclaimer:** The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Environment Programme/Mediterranean Action Plan concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The Secretariat is also, not responsible for the use that may be made of information provided in the tables and maps of this report. Moreover, the maps serve for information purposes only, and may not and shall not be construed as official maps representing maritime borders in accordance with international law.

## Table of Contents



**Annexes:**

## List of Abbreviations / Acronyms

| | |
|---|---|
| **ADR** | Adriatic Sea sub-region |
| **AEL** | Aegean and Levantine Seas sub-region |
| **AZ** | Assessment Zone |
| **BAC** | Background Assessment Concentrations |
| **BC** | Background Concentration |
| **C** | Concentration |
| **CHASE+** | Chemical Status Assessment Tool |
| **CI** | Common Indicator |
| **CR** | Contamination Ratio |
| **CS** | Contamination Score |
| **EAC** | Environmental Assessment Criteria |
| **EcoQOs** | Ecological Quality Objectives |
| **EEA** | European Environment Agency |
| **EQS** | Environmental Quality Standard |
| **GES** | Good Environmental Status |
| **IMAP** | Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria |
| **MAP** | Mediterranean Action Plan |
| **MB** | *Mullus barbatus* |
| **MED** | Mediterranean |
| **MED POL** | Programme for the Assessment and Control of Marine Pollution in the Mediterranean Sea |
| **MG** | *Mytilus galloprovincialis* |
| **NEAT** | Nested Environmental Status Assessment Tool |
| **NPA** | Non Problem Area |
| **PA** | Problem Area |
| **PAHs** | Polycyclic Aromatic Hydrocarbons |
| **PCB** | Polychlorinated Biphenyl |
| **QSR** | Quality Status Report |
| **SAU** | Spatial Assessment Units |
| **SD** | Sub division |
| **TM** | Trace metals |
| **UNEP** | United Nations Environmental Program |

## 1. Introduction

1. UNEP/MAP-Barcelona Convention has received funding from the UNEP Regional Seas Programme 2021 SIDA allocation for a project entitled "Towards integrated ecosystem assessment and ecosystems management approach in the Adriatic" (SIDA project in the Adriatic). The objective of this project is to test and validate as appropriate a quantitative good environmental status (GES) assessment related to the IMAP Common Indicators that correspond to UNEP Regional Seas Indicators. Specifically, UNEP/MAP will test the Nested Environmental status Assessment Tool (NEAT) application as appropriate for GES assessment in the Adriatic Sea Sub-region area, to identify the pressures at a level to inform taking appropriate, targeted measures and actions in the area. Moreover, the assessment findings generated by the application of NEAT will be compared to another selected assessment methodology in order to decrease the uncertainty of the assessment results within the preparation of the 2023 MED QSR. The selected methodology should have been applied in a different sub-divisions of the Mediterranean Sea sub-regions.

2. NEAT tool application for GES assessment of IMAP Common Indicator CI-17 was applied for the Adriatic Sea Sub-region (UNEP/MED WG.533/10, Appendix III and UNEP/MED WG.533/Inf.4/Rev.1). Similarly, the CHASE+ methodology was used to assess the quality status of the Levantine Sea Basin concerning CI-17 (UNEP/MED WG.533/10, Appendix IV). This document presents the inter-comparison of the results of the environmental assessment of the Adriatic Sea using NEAT to the results using CHASE+ for Trace metals (TM), $\Sigma_{16}$ PAHs and $\Sigma_7$ PCBs in sediments and for TM and $\Sigma_7$ PCBs in biota *(M. galloprovincialis).* These were all the CI-17 parameters available for this Sub-region. The purpose of this inter-comparison is to determine if the two approaches are compatible. If so, it will be possible to harmonize among assessments performed in different sub-regions and sub-divisions, with different number of sampling locations and measurements. This is needed to avoid possible bias in the Mediterranean regional assessment, that may occur as a result of the use of different approaches. 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 Sea Sub-region, even though there were still data and spatial gaps (UNEP/MED WG. 533/Inf.3/Rev.1). Data availability was lower for the Levantine Sea Basin Sub-division compared to the Adriatic Sea Sub-region, but higher compared to other sub-regions or sub-divisions.

## 2. Application of CHASE+ in the Adriatic Sea sub-region

3. The methodology for CHASE+ assessment is described in UNEP/MED WG.533/Inf.3/Rev.1, UNEP/MED WG.533/10, Appendix IV, and EEA, 2019. Briefly, the CHASE+ consists of Contamination Ratios (CR) calculation for each element, followed by the Contamination Score (CS) calculation, aggregating the elements as follows:

$CR = C_{measured}/C_{threshold}$ where C is the concentration of contaminant assessed,

$$CS = \frac{1}{\sqrt{n}} \sum_{i=1}^{n} CR_i$$ where n is the number of elements assessed.

4. Based on CRs and CSs the stations/areas are classified into non problem area (NPA, in GES) and problem area (PA, non-GES), by applying 5 categories: i) Blue - NPAhigh (CR or CS=0.0-0.5); ii) Green-NPAgood (CR or CS =0.5-1.0); iii)Yellow- PAmoderate (CR or CS =1.0-5.0); iv) Brown - PApoor (CR or CS =5.0-10.0) and v) Red - PAbad (CR or CS > 10.0) (Table 1). The boundary limit between GES and

non-GES was set as 1[1] by the European Environment Agency (EEA, 2019) while for the Levantine Sea Basin application it was set as 1.5[2] for trace metals and 2 for $\Sigma_{16}$ PAHs and $\Sigma_7$ PCBs[3] (Table 1) (UNEP/MED WG.533/10, Appendix IV) . For comparison, in the NEAT methodology, applied to the Adriatic Sea sub-region, 5 categories were defined as: i) high status (Blue) where 0 (best conditions) < $C_{measured}$ ≤BAC range; ii) the good status (Green) where BAC < $C_{measured}$≤ MedEAC; iii) moderate status (Yellow) where MedEAC < $C_{measured}$ ≤ 3xMedEAC; iv) the poor and bad statuses (Brown) where 3xMedEAC< $C_{measured}$ ≤ Max. conc. (worse conditions), with the bad status having the highest distance from the 3xMedEAC threshold (UNEP/MED WG.533/10, Appendix III; UNEP/MED WG.533/Inf.4/Rev.1). The poor and bad status in NEAT were categorized together (Table 1).

**Table 1.** Comparison among the GES classification categories and boundary limits used in the pilot GES assessments of the Adriatic Sea (using NEAT) and the Levantine Sea Basin (using CHASE+). The table is elaborated in UNEP/MED WG.533/10, Appendix IV.

| | **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 | |
| | | | | | |

[1] 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.

[2] 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 MED_EACs as threshold (UNEP/MED WG.533/10, Appendix III). By setting the boundary limit at 1.5, the GES status is possible for some of the measured concentrations above the values of BACs used as thresholds. 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.

[3] 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). For CR to equals 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. This more lenient classification is proposed due 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 in UNEP/MED WG.533/10, Appendix IV).

| **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 *biota (*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** |
| **$\Sigma_{16}$ PAHs and $\Sigma_7$ 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 |

*Biota. *M. barbatus* in the Levantine Basin and *M. galloprovincialis* in the Adriatic Sea.

5. The CHASE+ methodology in the Adriatic Sea was applied using the ADR_BACs as thresholds (Table 2). The rational for this choice was to use the same category of thresholds used in the CHASE+ application in the Levantine (AEL_BACs)[4]. The boundary limit between GES and non-GES was 1.5 for trace metals and 2 for $\Sigma_{16}$ PAHs and $\Sigma_7$ PCBs based on the ADR_BACs threshold as used for the CHASE+ application in the Levantine Basin. These choices of boundaries are explained in document UNEP/MED WG.533/10, Appendix IV, with key aspects explained in footnotes here- above.

**Table 2.** Threshold values (ADR_BACs) used in CHASE+ application for the Adriatic Sea. MED_EACs are shown for comparison as well as the ratio between the two criteria.

| | **ADR_BAC (µg/kg)** | **MED_EAC (µg/kg)** | **Ratio MED_EAC/ADR_BAC** |
|---|---|---|---|
| Sediment | | | |
| Cd | 180 | 1200 | 6.67 |
| Hg | 75 | 150 | 2.00 |
| Pb | 23500 | 46700 | 1.99 |
| $^{*}\Sigma_{16}$ PAHs | 197 | 4022 | 20.4 |
| $^{+}\Sigma_7$ PCBs | 0.32 | 68 | 212.5 |
| Biota | | | |
| Cd | 1052 | 5000 | 4.75 |
| Hg | 135 | 2500 | 18.5 |
| Pb | 1742 | 7500 | 4.31 |
| $^{+}\Sigma_7$ PCBs | 25 | 136 | 5.44 |

*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

[4] In EEA (2019) it is stated that: "In addition to monitoring data, the analyses require information about the substance- and matrix-specific threshold levels, i.e. the concentrations or effects that are used to decide if the levels are above or below what is regarded acceptable. Threshold values can be defined in different ways and those used here include Environmental Quality Standards (EQS), Environmental Assessment Criteria (EAC), Background Assessment Criteria (BAC) and Ecological Quality Objectives (EcoQOs)."

## 3. Approaches for comparison between NEAT and CHASE+ assessment results

6. The main challenge of the intercomparison between NEAT and CHASE+ assessments is that NEAT nests the sampling stations (under the same sub-SAU) into SAUs (Spatial assessment units), followed by nesting to assessment zones (AZ), followed by sub-divisions (SD) and sub-region (UNEP/MED WG.533/10, Appendix III). Moreover, the nested results are weighted averages, where the weight of a nesting level is not the simple ratio of each level surface area to the total surface area of the parent level. In CHASE+ there are no weighted averages. Therefore, the comparison was performed as follows:

i) Comparison of the results at the sub-SAU level. No weighted averages were calculated in NEAT at the sub-SAU levels. Therefore, it is possible to compare the results of the assessments obtained directly from each methodology with no further calculation.

ii) Comparison of the results at the SAUs and higher nesting levels. For this approach, the Contamination Ratios (CR) from the CHASE+ application were transformed into weighted values, based on the relative surface areas assessed and then compared to NEAT results. A sample calculation of the weighting process is presented in Annex I. According to NEAT assessment methodology (UNEP/MED WG.533/10, Appendix III and UNEP/MED WG. 533/Inf. 4/Rev.1), the weight factor used in NEAT is not the ratio between the relative surface areas. However, we used this here as the best approximation that can be applied to calculate the weighted CR values.

## 4. Results

### 4.1 Comparison of assessments at the sub-SAU level

7. The first step of the CHASE+ application to the Adriatic Sea was to calculate CRs for each sub-SAU and to assign them a GES classification category. The comparison of the CHASE+ and NEAT results is presented in Tables 3-5. As explained above, the comparison at the level of the sub-SAUs is straightforward, as no nesting and weighting were applied in NEAT at this level.

8. Trace metals in sediments (Table 3): Comparison of GES and non-GES status for the sub-SAUs as determined by NEAT and CHASE+ showed a very good agreement for trace metals in sediments. There were only 3 sub-SAUs (out of 39 sub-SAUs available for comparison) with different classification: HRO-0423-RILP where Cd and Pb were non-GES in CHASE+, MNE-1C and MNE-Kotor, where Cd was non-GES in CHASE+. It can be concluded, that for TM in sediments at the sub-SAUs level, the NEAT and the CHASE+ provide the same GES classification.

9. $\Sigma_{16}$ PAHs in sediments (Table 4): For $\Sigma_{16}$ PAHs there were only 9 sub-SAUs available for comparison. The results for the 5 sub-SAUs belonging to IT-NAS-1 and MNE-SAS-12 were identical using both methodologies. The results for the sub-SAUs belonging to MNE-SAS-1 were different, with CHASE+ providing a worse classification. NEAT classified two sub-SAUs as in GES (green status) and two as non-GES (yellow status) while CHASE+ classified all the sub-SAUs as non-GES, with worse category than in NEAT. The comparison was hindered by the small number of sub-SAUs available for comparison. While the division of the stations by GES or non-GES status was the same for 7 out of the 9 stations using both methodologies, further data are needed to reach a conclusion because of the very different assignment of classes within the non-GES between the two methodologies.

10. $\Sigma_7$ PCBs in sediments (Table 4): For $\Sigma_7$ PCBs there were only 9 sub-SAUs available for comparison. The results for the sub-SAUs belonging to MNE-SAS-12 were identical using both methodologies. The results for the sub-SAUs belonging to IT-NAS-1 and MNE-SAS-1 were different, with CHASE+ providing a worse classification. The two sub-SAUS belonging to IT-NAS-1 were classified as in GES by NEAT (green status) while CHASE+ classified both sub-SAUs as non-GES in the

red bad status. Three sub-SAUS belonging to MNE-SAS-1 were classified as in GES using NEAT (one blue and two with green status) and one sub-SAU was classified as non-GES (yellow status). CHASE+ classified one sub-SAU as in GES (green status) and 3 sub-SAUs as non-GES. The probable reason for these large differences is the large difference between the BAC_ADR (0.32 µg/kg), used in CHASE+ and the MED_EAC (68 µg/kg), used in NEAT, a difference that cannot be reconciled even if using a more lenient boundary limit between GES and non-GES. The ratio between the two criteria is 212.5, while for TM and $\Sigma_{16}$ PAHs in sediments, the ratios ranged from 1.99 to 20.4 (Table 2). BACs were adopted by COPs decision to be used as thresholds in GES assessment. However, just for the sake of this specific comparison we used 10xBACs as a hypothetical threshold to check if this improved the comparisons. Therefore, an additional threshold of 10x BAC_ADR was used to recalculate CR for $\Sigma_7$ PCBs in sediments. The rational of this choice was to reduce the ratio between the thresholds from 212.5 to 21.3, similar to the ratio for $\Sigma_{16}$ PAHs in sediments. The results of the comparison showed a very good agreement for all sub-SAUs, with a slight difference in the GES classification for MNE-1-S (green and blue for NEAT and CHASE+, respectively), and the non-GES classification for MNE-Kotor (yellow and red for NEAT and CHASE+, respectively).

11. Trace metals in biota (*M. galloprovincialis*) (Table 5): Comparison of GES and non-GES status for the sub-SAUs as determined by NEAT and CHASE+ showed a very good agreement for TM in biota. There were only 2 sub-SAUs (out of 22 sub-SAUs available for comparison) with different classification: HRO-0413-PZK where Pb was non-GES in NEAT and in GES using CHASE+, and MNE-Kotor where Pb was in GES in NEAT and non-GES in CHASE+. It can be concluded, that for TM in biota at the sub-SAUs level, the NEAT and the CHASE+ provide the same GES classification.

12. $\Sigma_7$ PCBs in biota (*M. galloprovincialis*) (Table 5): Comparison of GES and non-GES status for the sub-SAUs as determined by NEAT and CHASE+ showed a very good agreement for $\Sigma_7$ PCBs in biota. There were only 3 sub-SAUs (out of 22 sub-SAUs available for comparison) that NEAT classified as in GES while CHASE+ classified as non-GES (yellow status): HRO-0413-PZK, HRO-0423-KOR and HRO-313_ZUC. It can be concluded, that for $\Sigma_7$ PCBs in biota at the sub-SAUs level, the NEAT and the CHASE+ provide the same GES classification.

13. **To summarize, at the sub-SAUs level, there is a very good agreement between the assessments performed with NEAT and CHASE+ for TM in sediments, TM in biota and $\Sigma_7$ PCBs in biota. For $\Sigma_{16}$ PAHs in sediments, although the classifications of most sub-SAUs are in agreement, further data are needed to reach a conclusion. In the case of $\Sigma_7$ PCBs in sediments, the two methodologies gave different assessments due to the very large difference between the ADR_BAC and the MED_EAC. NEAT assessment was more lenient and CHASE+ more stringent. There was a very good agreement between the two methodologies when an hypothetical threshold of 10xADR_BAC was used.**

**Table 3**. Results of NEAT[5] and CHASE+ methodologies applied to TM in sediments of the Adriatic Sea, at the sub-SAUs level. Blank cells denote absence of data at the sub-SAU level. Blue and Green areas are in GES, while yellow, brown and red indicate non-GES areas. In parenthesis, the applied boundary limit between GES and non-GES for CHASE+.

| | *NEAT | | | #CHASE+ (1.5) | | |
|---|---|---|---|---|---|---|
| | **Cd** | **Hg** | **Pb** | **Cd** | **Hg** | **Pb** |
| **North Adriatic** | | | | | | |
| **MAD-HR-MRU-3** | | | | | | |
| HRO-0313-JVE | 0.853 | 0.872 | 0.755 | 0.73 | 0.64 | 1.22 |
| HRO-0313-BAZ | 0.790 | 0.475 | 0.591 | 1.29 | 4.51 | 2.16 |

[5] Table 3 from UNEP/MED WG.533/10, Appendix III

| | *NEAT | | | #CHASE+ (1.5) | | |
|---|---|---|---|---|---|---|
| | **Cd** | **Hg** | **Pb** | **Cd** | **Hg** | **Pb** |
| HRO-0412-PULP | 0.803 | 0.330 | 0.572 | 0.98 | 39.91 | 2.53 |
| HRO-0412-ZOI | 0.894 | 0.861 | 0.874 | 0.53 | 0.70 | 0.63 |
| HRO-0413-LIK | 0.886 | 0.781 | 0.710 | 0.57 | 1.09 | 1.44 |
| HRO-0413-PAG | 0.832 | 0.837 | 0.780 | 0.84 | 0.81 | 1.10 |
| HRO-0413-RAZ | 0.852 | 0.883 | 0.770 | 0.74 | 0.58 | 1.15 |
| HRO-0422-KVV | 0.867 | 0.915 | 0.849 | 0.67 | 0.43 | 0.76 |
| HRO-0422-SJI | 0.916 | 0.944 | 0.906 | 0.42 | 0.29 | 0.47 |
| HRO-0423-KVA | 0.879 | 0.893 | 0.817 | 0.61 | 0.54 | 0.92 |
| HRO-0423-KVJ | 0.888 | 0.907 | 0.795 | 0.56 | 0.46 | 1.02 |
| HRO-0423-KVS | 0.903 | 0.853 | 0.847 | 0.48 | 0.73 | 0.77 |
| HRO-0423-RILP | 0.728 | 0.712 | 0.682 | 3.04 | 1.44 | 1.58 |
| HRO-0423-RIZ | 0.877 | 0.861 | 0.763 | 0.61 | 0.69 | 1.18 |
| HRO-0423-VIK | 0.869 | 0.749 | 0.768 | 0.66 | 1.26 | 1.16 |
| **IT-NAS-1** | | | | | | |
| IT-Em-Ro-1 | 0.801 | 0.723 | 0.869 | 0.99 | 1.39 | 0.66 |
| IT-Fr-Ve-Gi-1 | 0.843 | 0.315 | 0.712 | 0.78 | 47.2 | 1.43 |
| IT-Ve-1 | 0.755 | 0.406 | 0.870 | 2.29 | 5.88 | 0.65 |
| **Central Adriatic** | | | | | | |
| **MAD-HR-MRU-2** | | | | | | |
| HRO-0313-NEK | 0.799 | 0.824 | 0.744 | 1.04 | 0.87 | 1.28 |
| HRO-0313-KASP | 0.793 | 0.400 | 0.742 | 1.19 | 6.01 | 1.29 |
| HRO-0313-KZ | 0.816 | 0.427 | 0.810 | 0.92 | 5.47 | 0.95 |
| HRO-0313-MMZ | 0.837 | 0.896 | 0.794 | 0.81 | 0.52 | 1.03 |
| HRO-0413-PZK | 0.887 | 0.768 | 0.783 | 0.57 | 1.16 | 1.08 |
| HRO-0413-STLP | 0.798 | 0.477 | 0.820 | 1.05 | 4.46 | 0.90 |
| HRO-0423-BSK | 0.800 | 0.752 | 0.796 | 1.00 | 1.25 | 1.02 |
| HRO-0423-KOR | 0.886 | 0.893 | 0.888 | 0.57 | 0.53 | 0.56 |
| HRO-0423-MOP | 0.854 | 0.941 | 0.852 | 0.73 | 0.30 | 0.74 |
| **IT-CAS-1** | | | | | | |
| IT-Ab-1 | 0.809 | 0.867 | 0.932 | 0.95 | 0.67 | 0.34 |
| IT-Ma-1 | 0.793 | | 0.947 | 1.19 | | 0.26 |
| IT-Mo-1 | 0.864 | 0.712 | 0.934 | 0.68 | 1.44 | 0.33 |
| **South Adriatic** | | | | | | |
| **MAD-HR-MRU-2** | | | | | | |
| HRO-0313-ZUC | 0.843 | 0.888 | 0.903 | 0.76 | 0.61 | 1.17 |
| HRO-0423-MOP | 0.849 | 0.877 | 0.765 | 0.78 | 0.56 | 0.49 |
| **MNE-SAS-1** | | | | | | |
| MNE-1-N | 0.797 | 0.944 | 0.961 | 1.09 | 0.28 | 0.20 |
| MNE-1-C | 0.772 | 0.569 | 0.572 | 1.79 | 2.61 | 2.53 |
| MNE-1-S | 0.852 | 0.861 | 0.931 | 0.74 | 0.70 | 0.34 |
| MNE-Kotor | 0.663 | 0.354 | 0.508 | 4.88 | 28.53 | 3.80 |

| | *NEAT | | | #CHASE+ (1.5) | | |
|---|---|---|---|---|---|---|
| | **Cd** | **Hg** | **Pb** | **Cd** | **Hg** | **Pb** |
| **MNE-SAS-12** | | | | | | |
| MNE-12-N | 0.894 | 0.949 | 0.826 | 0.53 | 0.25 | 0.87 |
| MNE-12-C | 0.886 | 0.941 | 0.809 | 0.57 | 0.29 | 0.96 |
| MNE-12-S | 0.869 | 0.917 | 0.755 | 0.66 | 0.42 | 1.22 |

***** MED EAC used as threshold between GES-non GES classification
# 1.5xADR_BAC used as threshold between GES-non GES classification

**Table 4**. Results of NEAT[6] and CHASE+ methodologies applied to $\Sigma_{16}$ PAHs and $\Sigma_7$ PCBs in sediments of the Adriatic Sea, at the sub-SAUs level. Blue and Green areas are in GES, while yellow, brown and red indicate non-GES areas. In parenthesis, the applied boundary limit between GES and non-GES for CHASE+. The results of the CHASE+ method using 10xADR_BAC as threshold for $\Sigma_7$ PCBs are presented as well.

| | $\Sigma_{16}$ PAHs | | $\Sigma_7$ PCBs | | $\Sigma_7$ PCBs |
|---|---|---|---|---|---|
| **Sediment** | **NEAT** | **CHASE+ (2.0)** | **NEAT** | **CHASE+ (2.0)** | **CHASE+ (2.0) with 10xADR_BAC as hypothetical threshold** |
| **North Adriatic** | | | | | |
| **IT-NAS-1** | | | | | |
| IT-Em-Ro-1 | 0.798 | 1.20 | 0.789 | 12.12 | 1.21 |
| IT-Ve-1 | 0.796 | 1.34 | 0.791 | 10.95 | 1.09 |
| **South Adriatic** | | | | | |
| **MNE-SAS-1** | | | | | |
| MNE-1-N | 0.74 | 6.80 | 0.869 | 0.66 | 0.07 |
| MNE-1-C | 0.773 | 3.60 | 0.795 | 6.15 | 0.62 |
| MNE-1-S | 0.583 | 23.9 | 0.799 | 2.13 | 0.21 |
| MNE-Kotor | 0.514 | 38.0 | 0.578 | 258 | 25.82 |
| **MNE-SAS-12** | | | | | |
| MNE-12-N | 0.97 | 0.15 | 0.944 | 0.28 | 0.03 |
| MNE-12-C | 0.982 | 0.09 | 0.919 | 0.41 | 0.04 |
| MNE-12-S | 0.98 | 0.10 | 0.95 | 0.23 | 0.02 |

**Table 5**. Results of NEAT[7] and CHASE+ methodologies applied to trace metals and $\Sigma_7$ PCBs in biota (*M. galloprovincialis*) of the Adriatic Sea, at the sub-SAUs level. Blue and Green areas are in GES, while yellow, brown and red indicate non-GES areas. In parenthesis, the applied boundary limit between GES and non-GES for CHASE+.

| | **Cd** | **Hg** | **Pb** | **Cd** | **Hg** | **Pb** | **$\Sigma_7$ PCBs** | **$\Sigma_7$ PCBs** |
|---|---|---|---|---|---|---|---|---|
| | **NEAT** | | | **CHASE+ (1.5)** | | | **NEAT** | **CHASE+ (2.0)** |
| **North Adriatic** | | | | | | | | |

[6] Table 3 from UNEP/MED WG.533/10, Appendix III
[7] Table 3 from UNEP/MED WG.533/10, Appendix III

| | Cd | Hg | Pb | Cd | Hg | Pb | $\Sigma_7$ PCBs | $\Sigma_7$ PCBs |
|---|---|---|---|---|---|---|---|---|
| **NAS-1** | | | | | | | | |
| **MAD-HR-MRU-3** | | | | | | | | |
| HRO-0313-JVE | 0.8 | 0.795 | 0.797 | 1.00 | 1.42 | 1.06 | 0.759 | 1.91 |
| HRO-0412-ZOI | 0.901 | 0.88 | 0.878 | 0.50 | 0.60 | 0.61 | 0.864 | 0.67 |
| HRO-0413-LIK | 0.862 | 0.84 | 0.871 | 0.69 | 0.80 | 0.65 | 0.856 | 0.70 |
| HRO-0413-PAG | 0.856 | 0.877 | 0.84 | 0.72 | 0.61 | 0.80 | 0.786 | 1.32 |
| HRO-0422-KVV | 0.826 | 0.8 | 0.814 | 0.87 | 1.03 | 0.93 | 0.782 | 1.39 |
| HRO-0422-SJI | 0.843 | 0.879 | 0.842 | 0.78 | 0.61 | 0.79 | 0.796 | 1.08 |
| HRO-0423-KVA | 0.863 | 0.874 | 0.882 | 0.69 | 0.63 | 0.59 | 0.848 | 0.77 |
| HRO-0423-KVJ | 0.8 | 0.862 | 0.922 | 1.00 | 0.69 | 0.39 | 0.777 | 0.91 |
| HRO-0423-KVS | 0.848 | 0.828 | 0.796 | 0.76 | 0.86 | 1.07 | | 1.53 |
| HRO-0423-RIZ | 0.802 | 0.799 | 0.791 | 0.99 | 1.09 | 1.14 | 0.816 | 0.94 |
| HRO-0423-VIK | 0.814 | 0.841 | 0.798 | 0.93 | 0.79 | 1.03 | 0.912 | 0.43 |
| **Central Adriatic** | | | | | | | | |
| **CAS-1** | | | | | | | | |
| **MAD-HR-MRU-2** | | | | | | | | |
| HRO-0313-NEK | 0.873 | 0.887 | 0.899 | 0.64 | 0.56 | 0.50 | 0.832 | 0.85 |
| HRO-0313-KASP | 0.888 | 0.799 | 0.811 | 0.56 | 1.06 | 0.94 | 0.016 | 6.93 |
| HRO-0313-MMZ | 0.846 | 0.846 | 0.808 | 0.77 | 0.77 | 0.96 | 0.795 | 1.13 |
| HRO-0413-PZK | 0.86 | 0.868 | 0.4 | 0.70 | 0.66 | 1.39 | 0.723 | 2.70 |
| HRO-0423-BSK | 0.829 | 0.849 | 0.831 | 0.85 | 0.75 | 0.84 | 0.864 | 0.68 |
| HRO-0423-KOR | 0.863 | 0.849 | 0.799 | 0.68 | 0.76 | 1.01 | 0.699 | 3.24 |
| **South Adriatic** | | | | | | | | |
| **SAS-1** | | | | | | | | |
| **MAD-HR-MRU-2** | | | | | | | | |
| HRO-0313-ZUC | 0.807 | 0.867 | 0.799 | 0.97 | 0.66 | 1.02 | 0.748 | 2.16 |
| HRO-0423-MOP | 0.81 | 0.809 | 0.775 | 0.95 | 0.96 | 1.41 | 0.756 | 1.98 |
| **MNE-SAS-1** | | | | | | | | |
| MNE-1-C | 0.787 | 0.846 | 0.324 | 1.24 | 0.77 | 28.8 | 0.888 | 0.57 |
| MNE-1-S | 0.987 | 0.978 | 0.981 | 0.06 | 0.11 | 0.09 | 0.99 | 0.05 |
| MNE-Kotor | 0.873 | 0.873 | 0.74 | 0.64 | 0.63 | 1.99 | 0.888 | 0.56 |

### 4.2 Comparison of assessments at the SAUs and higher nesting levels

14. The second step of the CHASE+ application to the Adriatic Sea was to calculate CRs for each spatial assessment unit (SAU), assessment zone (AZ) and sub-division (SD) weighting them according to their relative surface area, and to assign a GES classification category. The comparison of the results is presented in Tables 6-8. As explained above, the comparison at these nesting levels required considering the relative surface area each level encompasses (See Annex I for sample calculation).

15. Trace metals in sediments (Table 6): Comparison of GES and non-GES status for different nesting levels as determined by NEAT and CHASE+ showed a very good agreement. There were only 3 SAUs (out of 16) with different classification: IT-NAS-1 that was classified as in GES in NEAT and as non-GES for Hg in CHASE+; MAD-Sl-MRU-11 was classified as non-GES in NEAT but in GES in

CHASE+ for Hg, and MNE-SAS-1 that was classified as GES in NEAT and as non-GES for all TM in CHASE+. Out of the 6 AZs, only the NAS-1 was classified as non-GES for Hg in the CHASE+ as opposed to GES in NEAT. It can therefore be concluded, that at the SAUs and higher nesting levels, the NEAT and the CHASE+ provide the same classification.

16. $\Sigma_{16}$ PAHs in sediments (Table 7): Comparison of GES and non-GES status for different nesting levels as determined by NEAT and CHASE+ showed a very good agreement. Out of the 8 SAUs, 5 AZs and 3 SDs only one SAU (MNE-SAS-1) was classified as non-GES by CHASE+ and as in GES by NEAT.

17. $\Sigma_7$ PCBs in sediments (Table 7): Four SAUs, 4 AZs and 2 SDs were available for comparison. Most of the assessments were different, with CHASE+ providing a worse classification. The same was true for the comparison at the sub-SAU level (Section 4.1). Using an hypothetical threshold of 10x BAC_ADR between GES – non GES classification in CHASE+, the comparison showed an agreement between the assessments of both methodologies, except for one SAU (MNE-SAS-1), that was classified as non-GES by CHASE+ and as in GES by NEAT.

18. Trace metals in biota (*M. galloprovincialis*) (Table 8): Eight SAUs, 5 AZs and 3 SDs were available for comparison. There were 3 SAUs that were classified as non-GES by CHASE+ while in GES by NEAT for: Hg in IT-NAS-12 and IT-CAS-12 and Pb in MNE-SAS-1. One AZ was classified as non-GES (CAS-12), however very close to being classified in GES (score of 1.66 as opposed to 1.5 to be classified as GES). It can be concluded that for TM in biota, the NEAT and the CHASE+ provide the same GES classification.

19. $\Sigma_7$ PCBs in biota (*M. galloprovincialis*) (Table 8): Four SAUs, 3 AZs and 3 SDs were available for comparison. Both methods assigned GES status to all areas.

20. **To summarize, at the SAUs and higher nesting levels, there is a very good agreement between the assessments performed with NEAT and CHASE+ for TM and $\Sigma_{16}$ PAHs in sediments, and for TM and $\Sigma_7$ PCBs in biota. In the case of $\Sigma_7$ PCBs in sediments, the two methodologies gave different assessments due to the very large difference between the ADR_BAC and the MED_EAC. NEAT assessment was more lenient and CHASE+ more stringent. There was a very good agreement between the two methodologies when an hypothetical threshold of 10xADR_BAC was used. The results of this comparison at the SAU and higher nesting levels are true provided that the relative surface areas are used to calculate weighted CR values in the CHASE+ methodology.**

**Table 6**. Results of NEAT[8] and CHASE+ methodologies applied to TM in sediments of the Adriatic Sea, divided in SAUs and higher nesting levels (AZ- assessment zone, SD- sub-division). Blank cells denote absence of data. Blue and Green areas are in GES, while yellow, brown and red indicate non-GES areas. In parenthesis, the applied boundary limit between GES and non-GES. The CHASE+ results are the weighted CR values, calculated from the relative surface areas.

| | **Area** | | **NEAT** | | | **CHASE+ (1.5)** | | |
|---|---|---|---|---|---|---|---|---|
| | **Km²** | | **Cd** | **Hg** | **Pb** | **Cd** | **Hg** | **Pb** |
| **Adriatic Sea** | **139783** | | **0.856** | **0.822** | **0.881** | **0.47** | **0.61** | **1.39** |
| **North Adriatic** | **31856** | **SD** | **0.849** | **0.536** | **0.836** | **0.64** | **4.69** | **0.69** |
| **NAS-1** | **9069** | **AZ** | **0.855** | **0.722** | **0.832** | **0.88** | **4.55** | **0.80** |
| MAD-HR-MRU-3 | 6422 | SAU | 0.892 | 0.891 | 0.84 | 0.53 | 0.57 | 0.78 |
| IT-NAS-1 | 2592 | SAU | 0.789 | 0.416 | 0.819 | 1.77 | 14.40 | 0.83 |
| MAD-Sl-MRU-11 | 55 | SAU | 0.889 | | 0.762 | 0.003 | 0.03 | 0.01 |

[8] Table 3 from UNEP/MED WG.533/10, Appendix III

| | Area | | NEAT | | | CHASE+ (1.5) | | |
|---|---|---|---|---|---|---|---|---|
| | Km² | | Cd | Hg | Pb | Cd | Hg | Pb |
| **NAS-12** | **22788** | **AZ** | **0.844** | **0.4** | **0.84** | **0.36** | **2.81** | **0.37** |
| IT-NAS-12 | **63696** | SAU | 0.844 | 0.4 | 0.84 | 0.78 | 6.08 | 0.80 |
| **Central Adriatic** | 7302 | **SD** | **0.85** | **0.861** | **0.893** | **0.68** | **0.60** | **0.40** |
| **CAS-1** | 2092 | **AZ** | **0.843** | **0.881** | **0.876** | **0.49** | **0.40** | **0.46** |
| MAD-HR-MRU-2 | **54303** | SAU | 0.855 | 0.9 | 0.848 | 0.52 | 0.45 | 0.55 |
| IT-CAS-1 | 18963 | SAU | 0.815 | 0.786 | 0.94 | 0.38 | 0.25 | 0.12 |
| **CAS-12** | 22393 | **AZ** | **0.851** | **0.858** | **0.896** | **0.71** | **0.64** | **0.39** |
| MAD-HR-MRU-4 | **44231** | SAU | 0.887 | 0.909 | 0.894 | 0.57 | 0.46 | 0.53 |
| IT-CAS-12 | **7276** | SAU | 0.791 | 0.771 | 0.899 | 1.25 | 1.15 | 0.50 |
| **South Adriatic** | 4252 | **SD** | **0.866** | **0.865** | **0.881** | **0.51** | **0.60** | **0.42** |
| **SAS-1** | 1810 | **AZ** | **0.847** | **0.804** | **0.837** | **0.62** | **1.41** | **0.35** |
| MAD-HR-MRU-2 | 483 | SAU | 0.849 | 0.877 | 0.766 | 0.33 | 0.23 | 0.20 |
| IT-SAS-1 (Ap-1) | 646 | SAU | 0.804 | 0.944 | 0.943 | 0.98 | 0.28 | 0.28 |
| MNE-SAS-1 | **36955** | SAU | 0.781 | 0.681 | 0.726 | 2.19 | 6.62 | 2.10 |
| AL-SAS-1 | 22715 | SAU | 0.917 | 0.395 | 0.943 | 0.42 | 8.60 | 0.28 |
| **SAS-12** | 2076 | **AZ** | **0.868** | **0.872** | **0.886** | **0.49** | **0.44** | **0.44** |
| IT-SAS-12 | 716 | SAU | 0.861 | 0.877 | 0.891 | 0.69 | 0.61 | 0.55 |
| MNE-SAS-12 | 2253 | SAU | 0.881 | 0.933 | 0.791 | 0.59 | 0.33 | 1.04 |
| AL-SAS-12 | **31856** | SAU | 0.924 | 0.587 | 0.915 | 0.38 | 2.25 | 0.43 |
| MAD-EL-MS-AD | **9069** | SAU | 0.914 | | 0.884 | 0.43 | | 0.58 |

**Table 7**. Results of NEAT[9] and CHASE+ methodologies applied to $\Sigma_{16}$ PAHs and $\Sigma_7$ PCBs in sediments of the Adriatic Sea, divided in SAUs and higher nesting levels (AZ- assessment zone, SD- sub-division). Blank cells denote absence of data. Blue and Green areas are in GES, while yellow, brown and red indicate non-GES areas. In parenthesis, the applied boundary limit between GES and non-GES. The results of the CHASE+ method using 10xADR_BAC as threshold for $\Sigma_7$ PCBs are presented as well. The CHASE+ results are the weighted CR values, calculated from the relative surface areas.

| | Area (km²) | | $\Sigma_{16}$ PAHs | | $\Sigma_7$ PCBs | | $\Sigma_7$ PCBs |
|---|---|---|---|---|---|---|---|
| | | | **NEAT** | **CHASE+ (2.0)** | **NEAT** | **CHASE+ (2.0)** | **CHASE+ (2.0) with 10xADR_BAC as hypothetical threshold** |
| **Adriatic Sea** | **139783** | | **0.929** | **0.13** | **0.819** | **0.77** | **0.08** |
| **North Adriatic** | **31856** | **SD** | **0.91** | **0.20** | **0.795** | **2.61** | **0.26** |
| **NAS-1** | **9069** | **AZ** | **0.797** | **0.30** | **0.79** | **2.48** | **0.25** |
| IT-NAS-1 | 2592 | SAU | 0.797 | 1.02 | 0.79 | 8.69 | 0.87 |

[9] Table 3 from UNEP/MED WG.533/10, Appendix III

| | Area ($km^2$) | | $\Sigma_{16}$ PAHs | | $\Sigma_7$ PCBs | | $\Sigma_7$ PCBs |
|---|---|---|---|---|---|---|---|
| | | | **NEAT** | **CHASE+ (2.0)** | **NEAT** | **CHASE+ (2.0)** | **CHASE+ (2.0) with 10xADR_BAC as hypothetical threshold** |
| MAD-Sl-MRU-11 | 55 | SAU | 0.812 | 0.94 | | | |
| **NAS-12** | **22788** | **AZ** | **0.93** | **0.16** | **0.796** | **2.66** | **0.27** |
| IT-NAS-12 | 10540 | SAU | 0.93 | 0.35 | 0.796 | 5.75 | 0.58 |
| **Central Adriatic** | **63696** | **SD** | **0.981** | **0.04** | | | |
| **CAS-1** | **9394** | **AZ** | **0.981** | **0.02** | | | |
| IT-CAS-1 | 2092 | SAU | 0.981 | 0.013 | | | |
| IT-Ab-1 | 282 | SAU | 0.981 | 0.10 | | | |
| **CAS-12** | **54303** | **AZ** | | **0.05** | | | |
| IT_CAS_12 | 22393 | SAU | | 0.11 | | | |
| **South Adriatic** | **44231** | **SD** | **0.955** | **0.20** | **0.922** | **0.55** | **0.06** |
| **SAS-1** | **7276** | **AZ** | **0.681** | **1.14** | **0.81** | **3.28** | **0.33** |
| MNE-SAS-1 | 483 | SAU | 0.681 | 17.22 | 0.81 | 49.36 | 4.94 |
| **SAS-12** | **36955** | **AZ** | **0.964** | **0.02** | **0.938** | **0.02** | **0.002** |
| MNE-SAS-12 | 2076 | SAU | 0.978 | 0.11 | 0.938 | 0.30 | 0.03 |
| MAD-EL-MS-AD | 2253 | SAU | 0.956 | 0.22 | | | |

**Table 8.** Results of NEAT[10] and CHASE+ methodologies applied to trace metals and $\Sigma_7$ PCBs in biota (*M. galloprovincialis*) of the Adriatic Sea, divided in SAUs and higher nesting levels (AZ- assessment zone, SD- sub-division). Blank cells denote absence of data. Blue and Green areas are in GES, while yellow, brown and red indicate non-GES areas. In parenthesis, the applied boundary limit between GES and non-GES. The CHASE+ results are the weighted CR values, calculated from the relative surface areas.

| | **Area ($km^2$)** | | **Cd** | **Hg** | **Pb** | **Cd** | **Hg** | **Pb** | **$\Sigma_7$ PCBs** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **NEAT** | | | **CHASE+ (1.5)** | | | **NEAT** | **CHASE+ (2)** |
| **Adriatic Sea** | **139783** | | **0.835** | **0.785** | **0.805** | **0.14** | **0.96** | **0.48** | **0.78** | **0.12** |
| **Northern Adriatic Sea** | **31856** | **SD** | **0.836** | **0.791** | **0.848** | **0.16** | **0.89** | **0.15** | **0.814** | **0.20** |
| **NAS-1** | **9069** | **AZ** | **0.836** | **0.853** | **0.848** | **0.57** | **0.52** | **0.54** | **0.814** | **0.70** |
| MAD-HR-MRU-3 | 6422 | SAU | 0.836 | 0.854 | 0.847 | 0.81 | 0.72 | 0.75 | 0.814 | 0.98 |
| MAD-Sl-MRU-11 | 55 | SAU | 0.886 | 0.799 | 0.895 | 0.57 | 1.11 | 0.53 | | |
| **NAS-12** | **22788** | **AZ** | | **0.786** | | | **1.03** | | | |
| IT-NAS-12 | 10540 | SAU | | 0.786 | | | 2.23 | | | |
| **Central Adriatic** | **63696** | **SD** | **0.856** | **0.768** | **0.788** | **0.03** | **1.45** | **0.04** | **0.741** | **0.10** |
| **CAS-1** | **9394** | **AZ** | **0.856** | **0.853** | **0.788** | **0.21** | **0.21** | **0.28** | **0.741** | **0.70** |

[10] Table 3 from UNEP/MED WG.533/10, Appendix III

| | Area ($km^2$) | | Cd | Hg | Pb | Cd | Hg | Pb | $\Sigma_7$ PCBs | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | NEAT | | | CHASE+ (1.5) | | | NEAT | CHASE+ (2) |
| MAD-HR-MRU-2_c | 7302 | SAU | 0.856 | 0.853 | 0.788 | 0.27 | 0.27 | 0.35 | 0.741 | 0.90 |
| **CAS-12** | **54303** | **AZ** | | **0.765** | | | **1.66** | | | |
| IT-CAS-12 | 22393 | SAU | | 0.765 | | | 4.02 | | | |
| **Southern Adriatic Sea** | **44231** | **SD** | **0.815** | **0.91** | **0.76** | **0.05** | **0.05** | **0.22** | **0.77** | **0.08** |
| **SAS-1** | **7276** | **AZ** | **0.815** | **0.91** | **0.76** | **0.28** | **0.30** | **1.34** | **0.77** | **0.51** |
| MAD-HR-MRU-2_s | 4252 | SAU | 0.81 | 0.809 | 0.775 | 0.40 | 0.40 | 0.59 | 0.756 | 0.82 |
| IT-SAS-1 (Ap-1) | 1810 | SAU | | 0.97 | | | 0.15 | | | |
| MNE-SAS-1 | 483 | SAU | 0.865 | 0.892 | 0.603 | 0.76 | 0.54 | 15.06 | 0.92 | 0.41 |

## 5. Key findings related to the application of the NEAT and CHASE+ assessment methodologies in the Adriatic Sea Sub-region

21. In the preparations of the 2023 MED QSR, the two different methodologies (NEAT and CHASE+) will be used to assign GES/non-GES classifications at different sub-regions and their sub-divisions: the NEAT methodology to be applied to the areas with sufficient data and the CHASE+ methodology to be applied to the areas with limited data available. Therefore, a comparison of the assessment findings derived by the NEAT and CHASE+ methodologies applied in the same sub-region or sub-division should be provided to increase reliability of related assessment findings. This is necessary to avoid possible bias in the sub-regional assessments in the Mediterranean region that may occur as a result of the use of the different assessment methodologies. At the time this technical paper was prepared, the Adriatic Sea Sub-region was the only area available for comparison: it was classified using NEAT (UNEP/MED WG.533/10, Appendix III) and using CHASE+ (UNEP/MED WG.533/10, Appendix IV), as presented in this document. An assessment for the Western Mediterranean Sea Sub-region (UNEP/MED WG.556/Inf.15) was completed (which extract was presented to the Meeting of the Project "Toward integration ecosystem assessment and ecosystems management approach"), using the NEAT tool and compared to the results using CHASE+. In the document, recommendations for future work towards the preparation of the 2023 QSR were given, as also presented here-below in Section 6.

22. Following are the key findings of this document that helped ascertain the recommendations as presented in Section 6. This technical paper was prepared prior to the NEAT application to the Western Mediterranean Sea. It guided work in WMS. However, the inter-comparison is the two directions process. Therefore, the work in WMS impacted in return findings presented in this technical paper. Consequently, some of the findings here listed may be a repetition of the recommendations presented in Section 6, while others may differ from the recommendations. As explained in Section 6, the recommendations were prepared based on the results of the comparisons of the environmental assessments performed for the Adriatic Sea Sub-region, the Levantine Sea Sub- division and the Western Mediterranean Sea Sub-region, and therefore they set the comparison rules to ensure compatible preparation of the assessments findings in all sub-regions/sub-divisions within the preparation of the 2023 MED QSR. The initial assessment findings prepared in the Adritic Sea Sub-region and Levantine Sea Basin will be revised in line with the final data that will be reported by 31$^{st}$ October, cutoff date for data reporting, and by applying the set of comparison rules as presented in Section 6 and the document for assessment of the WMS.

23. Only the CHASE+ methodology will be applied to areas with limited data. However, an interrelation of the assessment results applying the CHASE+ methodology with assessment results of other areas assessed by applying both the CHASE+ and the NEAT methodologies should be established.

The interrelation takes into account the results of the comparison of the different assessment methodologies as elaborated on the sub-SAU level, and SAU and higher nesting levels in the sections 4.1 and 4.2.

24. The assessment results of the Levantine Sea basin (UNEP/MED WG.533/10, Appendix IV) were interrelated with the assessment results derived for the Adriatic Sea Sub-region as it is here explained. The thresholds for the classification between GES/non-GES areas in the Adriatic Sea Sub-region were the MED_EAC for the NEAT methodology and the ADR_BAC for the CHASE+ methodology. Decision to apply different thresholds for different assessment methodologies was guided by the results of the initial application of the BACs within the assessment of the Levantine Sea Basin by applying the CHASE+ methodology. It was decided to apply BACs values for the application of the CHASE+ methodology given high values of the EACs in combination with the lack of the spatial assessment units nesting would result in non-reliable assessment findings.

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

26. The very good agreement of the NEAT and CHASE+ assessment results for most contaminants showed that the choice of different thresholds for NEAT and CHASE+ methodologies, based on data availability, was valid.

27. Contamination Ratios (CR) were calculated for each sub-SAU, and weighted CRs were calculated for the SAUs and higher nesting levels. The weighted CRs were calculated based on the relative surface area of each level. It must be emphasized that the weighted CR were used just for this comparison and are not used in the regular application of the CHASE+ methodology. This was necessary because NEAT uses weighting factors in the assessment of SAUs and higher nesting levels while CHASE+ does not. The weight factor used in NEAT is not the ratio between the relative surface areas but was used here as the best approximation that can be applied to calculate the weighted CR values.

28. No comparison was performed for the aggregated contaminants data (NEAT overall value vs contamination score (CS) in CHASE+) to obtain the overall pollution (CI17) assessment.

29. The assessment findings generated by the application of NEAT in the Adriatic Sea sub-region are in very good agreement with the assessment findings generated by the application of CHASE+ for trace metals in sediments and biota and in $\Sigma_7$ PCBs biota at the sub-SAUs, SAUs and higher nesting levels.

30. For $\Sigma_{16}$ PAHs in sediments at the sub-SAU level, further data are needed to reach a conclusion, although the classification of most sub-SAUs were in agreement. At the SAUs and higher nesting levels both methodologies were in very good agreement.

31. For $\Sigma_7$ PCBs in sediments the two methodologies gave different assessments due to the very large difference between the ADR_BAC (used as threshold in CHASE+) and the MED_EAC (used as threshold in NEAT). NEAT assessment was more lenient and CHASE+ more stringent. There was a very good agreement between the two methodologies at the sub-SAU, SAU and higher nesting levels when a hypothetical threshold of 10xADR_BAC was used.

32. Assessment of the remaining areas within the preparation of the 2023 MED QSR as well as update of assessments already performed, should be based on the interrelation set between the NEAT and CHASE+ assessment methodologies, as elaborated in this document and based on the recommendations in Section 6.

## 6. Recommendations for future work towards the preparation of the 2023 MED QSR

33. Further to the results of the comparison undertaken for the Adriatic Sea Sub-region, as presented above, an additional comparison between NEAT and CHASE+ assessments was recently prepared for the Western Mediterranean Sea Sub-region in order to further harmonize the final regional quality status assessment regarding CI17 in the Mediterranean Sea. The final assessment will be composed of individual assessments for each of the sub-regions and/or sub-divisions and therefore compatibility has to be assured.

34. The recommendations are based on the results of the assessments of the Adriatic Sea (ADR) Sub-region (UNEP/MED WG.533/10, Appendix III) and the comparison between the NEAT and CHASE+ applications, as described in this document; on the results of the Levantine Sea (LEVS) sub-division assessment using CHASE+ and comparison to the traffic light system (UNEP/MED WG.533/10, Appendix IV); and on the results of the Western Mediterranean Sea (WMS) Sub-region assessments using NEAT and CHASE+ (UNEP/MED WG.556/Inf.15). These same recommendations appear also in the WMS CI-17 assessment document.

35. A first step to achieve this is the use of compatible GES/non-GES threshold values for all sub-regions and sub-divisions. The MedEAC threshold was originally used for the assessment of the ADR, relying on the threshold values as agreed by Decisions IG.22/7 and IG.23/6. In the initial assessment of the LEVS it was found that this threshold does not fit the purpose of a meaningful assessment for this sub-division, and it was suggested to use GES/non-GES thresholds based on the BAC values of the area (xBAC, where x was 1.5 for TM and 2 for organic contaminants). In this way a finer classification of areas with concentrations >BAC was achieved in line with the precautionary principle. Recognizing sub-regional differences in the background concentrations, the (xBAC) approach is based on the relative distance of contaminants concentrations from the sub-regional BAC values, in contrast to the MedEAC threshold approach which is based on toxicological effects on biota species from other areas (EAC values developed by OSPAR were accepted for the Mediterranean by Decisions IG.22/7 and IG.23/6). Further comparison of this approach to the WMS showed that using the (xBAC) as GES/ non-GES thresholds clearly provided finer assessment classifications. To that end the assessment of the ADR using the NEAT should be updated by applying the (xBAC) GES/non-GES thresholds and using additional data if available from IMAP-IS.

36. For some sub-regions of the Mediterranean Sea, it was possible to define IMAP spatial assessment units (IMAP SAUs) based on the distribution of monitoring stations (e.g. the Adriatic Sea), while for others this was not possible (e.g. the Levantine Sea). A quality status assessment for all areas is desirable either on a SAU level, and if that is not possible on individual monitoring stations level. The NEAT tool has the ability to provide assessments in areas where SAUs are defined (e.g. Adriatic Sea; Western Mediterranean Sea). For areas where this is not possible, or where the data are limited, the CHASE+ tool has been tested for assessment at the stations level (e.g. Levantine Sea) (UNEP/MED WG.533/10, Appendix IV). The final quality status assessment results regarding CI17 for all sub-regions/sub-divisions of the Mediterranean Sea should be compatible regardless of the assessment methodology used.

37. Based on the documents[11] listed in paragraph 35, on the performance of the two NEAT and CHASE+ assessment methodologies in the sub-regions of the Mediterranean Sea using available data as reported by the CPs, it is concluded that the two assessment methodologies are compatible only on the very basic assessment per contaminant, per SAU. Still on this level some discrepancies appear for the non-GES categories moderate and poor. When aggregation of all contaminants data is attempted to obtain the overall pollution (CI17) assessment (NEAT overall value and contamination score (CS) in CHASE+),

[11] UNEP/MED WG.533/10, Appendix III; UNEP/MED WG.533/10, Appendix IV; UNEP/MED WG.556/Inf.15

the two tools behave differently. These discrepancies are related to different calculation methods for the aggregation of contaminants, as well as differences in setting the moderate/poor, poor/bad thresholds.

38. To overcome the above-described discrepancies and to ensure compatible assessments for all sub-regions of the Mediterranean Sea on the SAU and on station level for the purposes of the 2023 MED QSR, the approach described here-below is recommended. The approach is based on the application of a tailor-made assessment based on the general rationale of the CHASE+ tool while ensuring compatibility with the NEAT tool:

i. For all Sub-regions and for both NEAT and CHASE+ tools: The GES/non-GES boundaries should be based on the BAC values. The BAC values (xBAC) multiplied by 1.5 for Cd, Hg, Pb and by 2 for PAHs and PCBs were approved by the Meeting of CorMon Pollution (27 and 30 May 2022). This approach was chosen because it is based on the Mediterranean sub-regional background concentrations of contaminants and because it is more stringent than the Med_EAC approach. In many cases the Med_EAC thresholds are higher than the maximum value recorded for a particular contaminant, resulting in a very lenient classification of the SAUs/stations. In this way biased assessments in different Mediterranean sub-regions are avoided.

ii. For Sub-regions where the CHASE+ assessment methodology is applicable: Calculation of contamination ratios (CRs) based on the (xBAC) thresholds;

iii. For Sub-regions where the CHASE+ assessment methodology is applicable: Calculation of the CS for the overall CI17 aggregated assessment per station as a simple average of CRs and not as used by the EEA, where CS is calculated as the sum of CR divided by the square root of the number of CRs in the sum (Section 2, paragraph 3);

iv. For all Sub-regions: Align the moderate/poor and the poor/bad thresholds between the two assessment methodologies/the two tools. For the moderate/poor class, the use of 2(xBAC) value is proposed and for the poor/bad class, the 5(xBAC) value. In this way, a fine classification in line with the precautionary principle is expected. The NEAT tool is flexible and accepts either calculated thresholds values by the tool itself (based on the GES/ non-GES and the maximum concentration of contaminants), or threshold values predefined by the user. In this case all thresholds will be user defined. In the CHASE+ tool the CR or CS ratios for the moderate/poor and poor/bad classes will be set at 2x and 5x times the GES/ non-GES threshold, instead of x5 and x10 that are suggested by the tool. The proposed updating of the thresholds is shown in Table 9 below.

**Table 9**. Proposed updated assessment classification boundary limits/thresholds for a harmonized application of NEAT and CHASE+ tools in the Mediterannean Sea sub-regions.

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

| **CHASE+ Scores** | 0 <CR,CS ≤0.5 | 0.5<CR,CS≤ 1 | 1<CR,CS ≤ 2 | 2< CR,CS ≤5 | CR,CS> 5 |
|---|---|---|---|---|---|

# Annex I

## Example of calculation of weighted CR values in CHASE+, using relative surface areas provided by the NEAT approach.

The main challenge of the intercomparison between NEAT and CHASE+ assessments is that NEAT nests the sampling stations (under the same sub-SAU) into SAUs (Spatial assessment units), followed by nesting to assessment zones (AZ), followed by sub-divisions (SD) and sub-region (UNEP/MED WG.533/10, Appendix III). Moreover, the nested results are weighted averages, where the weight of a nesting level is not the simple ratio of each level surface area to the total surface area of the parent level. In CHASE+ there are no weighted averages. Therefore, for this comparison the CR values from the CHASE+ application were transformed into weighted CR values, based on the relative surface areas assessed and then compared to NEAT results. According to NEAT assessment methodology (UNEP/MED WG.533/10, Appendix III and UNEP/MED WG. 533/Inf 4/Rev.1), the weight factor used in NEAT is not the ratio between the relative surface areas. However, we used this here as the best approximation that can be applied to calculate the weighted CR values.

Below is a sample calculation of the weighted CR values, for TM in sediments, based on the data shown in Table A1.1.

**Table A1.1.** Data for the calculation of weighted CR as an example. Columns E, F and G present the CR calculated by CHASE+ and columns I, J, K the calculated weighted CR ( in bold) based on the relative surface areas (Column D). AZ- Assessment zone, SAU- Spatial assessment unit. Column C presents the name of the spatial unit and column D the area, as given in UNEP/MED WG.533/10, Appendix III.

| A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Area | CR | | | | Weighted CR | | |
| | | | ($km^2$) | Cd | Hg | Pb | | Cd | Hg | Pb |
| 3 | AZ | SAS-12 | 36955 | 0.63 | 0.62 | 0.74 | | **0.49** | **0.44** | **0.44** |
| 4 | SAU | IT-SAS-12 | 22715 | 0.69 | 0.61 | 0.55 | | 0.69 | 0.61 | 0.55 |
| 5 | SAU | MNE-SAS-12 | 2076 | 0.60 | 0.34 | 1.06 | | **0.59** | **0.33** | **1.04** |
| 6 | sub-SAU | MNE-12-N | 513 | 0.53 | 0.25 | 0.87 | | | | |
| 7 | sub-SAU | MNE-12-C | 713 | 0.57 | 0.29 | 0.96 | | | | |
| 8 | sub-SAU | MNE-12-S | 849 | 0.66 | 0.42 | 1.22 | | | | |
| 9 | SAU | AL-SAS-12 | 716 | 0.38 | 2.25 | 0.43 | | 0.38 | 2.25 | 0.43 |
| 10 | SAU | MAD-EL-MS-AD | 2253 | 0.43 | | 0.58 | | 0.43 | | 0.58 |

**Step 1. Calculate SAU weighed CR from sub- SAU CRs.**

Cd weighted CR for SAU MNE-SAS-12 (Row 5)= (E6*$D6+E7*$D7+E8*$D8)/$D5
Cd weighted CR for SAU MNE-SAS-12 (Row 5)= **0.59**=(0.53*513+0.57*713+0.66*849)/2076

In the same way, weighted CRs are calculated for Hg and Pb
Hg weighted CR for SAU MNE-SAS-12 (Row 5)= **0.33**=(0.25*513+0.29*713+0.42*849)/2076
Pb weighted CR for SAU MNE-SAS-12 (Row 5)= **1.04**=(0.87*513+0.96*713+1.22*849)/2076

When a SAU has no sub-SAUs or no data available at the sub-SAU level, the CR calculated by CHASE+ is used in step 2. See Rows 4,9 and 10 in Table A1.1.

**Step 2. Calculate AZ weighted CR from weigthed SAUs CR and original CRs when SAUs have no sub-SAU data.**

Cd weighted CR for AZ SAS-12 (Row 3)= =(I4*$D4+I5*$D5+I9*$D9+I10*$D10)/$D$3
Cd weighted CR for AZ SAS-12 (Row 3)= **0.49**=(0.69*22715+0.59*2076+0.38*716+0.43*2253)/36955

In the same way, weighted CRs are calculated for Hg and Pb
Hg weighted CR for AZ SAS-12 (Row 3)= **0.44**=(0.61*22715+0.33*2076+2.25*716+0*2253)/36955
Pb weighted CR for AZ SAS-12 (Row 3)= **0.44**=(0.55*22715+1.04*2076+0.43*716+0.58*2253)/36955

**Step 3. Continue in the same manner to higher nesting levels**

# Annex II

## References

EEA (2019) Contaminants in Europe's Seas. Moving towards a clean, non-toxic marine environment. EEA Report No 25/2018.

UNEP/MAP (2022). UNEP/MED WG.533/10, Appendix I. 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.

UNEP/MAP (2022). UNEP/MED WG.533/10, Appendix III. The Methodology and the Results of the NEAT Tool Application for GES assessment of IMAP Common Indicator 17 in the Adriatic Sea Sub-region.

UNEP/MAP (2022). UNEP/MED WG.533/10, Appendix IV. 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.

UNEP/MAP (2022). UNEP/MED WG.533/Inf.3/Rev.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.

UNEP/MAP (2022). UNEP/MED WG.533/Inf.5/Rev.1 : The GIS -based Layers for the Finest Areas of Assessment and the Areas of Assessment Nested to the Levels of Integration that are Considered Meaningful for Their Use Within NEAT Tool Application for the GES Assessment of the IMAP Common Indicator 17 of Ecological Objective 9, as well as for the Assessments related to Ecological Objectives 5 and 10.

UNEP/MAP (2023). UNEP/MED WG.556/Inf/7. The Results of GES Assessment for IMAP Common Indicator 17 in the Western Mediterranean Sea Sub-region by Applying the NEAT GES Assessment Methodology Harmonized with the CHASE+ Environmental Assessment Methodology