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Marine Litter CORMON

Application of the CHASE+ Assessment Tool for IMAP EO10 Marine Litter

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1. Introduction

1. All quality status environmental assessment methods, require two assessment criteria: (i) a threshold value for each parameter/element monitored, which defines the quality status; and (ii) a decision rule regarding the overall quality status for all parameters/elements within an assessment area. Then the GES assessment follows specific methods (i.e., numeric calculations) which aggregate and integrate the monitoring data at the appropriate assessment scales, as explained in UNEP/MED WG.492/13. For example, it is possible that an element/parameter measured across an assessment area gets values both above and below the threshold value (e.g., beach litter concentrations measured in 10 beaches is found above threshold in 3 of them and below threshold in 7 of them), so a decision needs to be taken regarding the achievement or not of GES for the particular assessment area or Spatial Assessment Unit.

2. Several methods and tools have been developed for the environmental assessment of marine areas and have been applied on the EU level, such as the CHASE+ and HEAT+ for determining the status of contaminants and eutrophication respectively (Andersen et al. 2016, 2022; EEA 2019a), the MESH+ for biodiversity and ecosystem health (EEA 2019b). All these tools define the status of areas defined by a spatial geographical grid (i.e. all areas cover the same surface).

3. Another tool is the NEAT multi-metric status assessment tool that has been applied successfully for several European marine areas (Berg et al, 2017; Borga et al, 2014; 2016; 2019; 2021, Kazanidis et al, 2020). The NEAT provides aggregated and integrated assessments on pre-defined geographical assessment areas (Spatial Assessment units- SAUs). The NEAT tool can integrate assessment data taking into account the different size of the SAUs and their position along the nested scheme. At the same time the NEAT tool aggregates several quality status components (i.e. contaminants, eutrophication, biodiversity etc) to reach to one quality status value for each SAU.

2. The application of CHASE+ toll

4. For the IMAP QSR 2023 the NEAT and CHASE+ tools have been harmonised and applied successfully for the assessment of contaminants (EO9) in the Mediterranean region and its sub-regions, with results produced by the two methodologies being highly comparable (UNEP/MED WG.556/Inf.6; UNEP/MED WG.556/Inf.7).

5. For Ecological Objective EO10 the NEAT methodology has been applied to the Adriatic Sea (UNEP/MED WG.550/12), because of the quite good spatial coverage for all EO10 parameters in the SAUs as already defined for the needs of the EO9 assessment (UNEP/MED WG.556/Inf.16). For the rest of the Mediterranean Sea sub-regions the use of the NEAT methodology would have resulted to high uncertainties due to the lack of homogeneity in terms of CI22, CI23 parameters measured for a given SAU. For this reason, an approach based on the CHASE+ methodology was followed in accordance also with the EO9 QSR2023 assessment for areas with limited data availability (UNEP/MED WG.556/Inf.8; UNEP/MED WG.550/12).

6. The basic concept of CHASE+ method is described below:

7. The first step in this tool is to calculate the ratio of the concentration for each assessment element to its threshold value $C_{measured}/C_{threshold}$ (C is the concentration) called the contamination ratio (CR). This is done for a specific matrix (water, sediments, biota) per monitoring station.

8. Since CHASE+ has been developed for assessing contaminants status, aggregation of the various CR per contaminant is needed for each matrix. This is done in a second step by calculating a contamination score (CS) as follows[1]:

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

Where n is the number of elements assessed for each matrix. Note that the CS is not a simple average of CRs but a square root average.

9. A more strict/precautionary approach is followed by using the square root of 'n' instead of 'n' in the denominator in order to account for synergistic effect of contaminants. Based on the contamination ratio (CR) or score (CS), each matrix is assessed as non- problem areas (NPA) when CR/CS is <1 and problem areas (PA) when CR/CS is >. A 5-status classification scheme is applied: NPA-high (Blue) (0.0 < CR/CS ≤0.5), NPA-good (Green) (0.5< CR/CS ≤ 1.0), PA-moderate (Yellow) (1.0< CR/CS ≤ 5.0), PA-poor (Brown) (5.0 < CR/CS ≤ 10.0) and PA-bad (Red) (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. The overall status of a grid cell for all matrices is determined by the worse case (one out all out principle OAOA).

10. Recently a similar approach, the prototype Marine Litter Assessment Tool (MALT), has been applied for the assessment of Marine Litter in Europe's Seas (Veiga et al., 2022). MALT has been developed using the same principles as these other tools, allowing assessments to be made in a uniform manner given varying forms and availability of indicators. The MALT tool differentiates from the CHASE+ in that it normalises data (log10) and the CRs (called Ecological Quality Ratios-EQR) to a scale from 0 to 1 so that the GES-nonGES boundary is defined by a score equal to 0.6, instead of 1, to allow indicators using different numerical scales to be compared in a consistent way. Furthermore, the 5 status classes are defined in equal intervals. In addition, for aggregation purposes simple averaging of EQRs is done. These calculations are similar to the ones followed by the NEAT tool. Aggregation is done by calculating the average of the EQR values of the included indicators. Finally, using a one-out all-out method (OOAO), the overall EQR is determined as the worst of the EQR values of the three categories Litter, Micro-litter and Biota.

11. For the EO10 assessment within the IMAP QSR2023, the approach followed is based on the CHASE+ tool. For each CI and each measured parameter (Beach litter, Seafloor Litter, Floating Microplastics) temporal data are averaged per monitoring station. The resulting average value is compared against the respective TV and the score ratio is calculated. Classification of stations is conducted following a 5-status classification scheme for macro-litter and 6 status for floating microplastics. No further aggregation on the EO10 level or spatial integration is conducted for the Mediterranean region or its sub-regions.

[1] 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'.

12. Similarities and differences of the various assessment tools described above and of the approach followed for the assessment of EO10 in QSR 2023 are summarized in Table 1. It is understood that for the present assessment of marine litter in the Mediterranean Region a simple comparison of stations data against the respective UNEP/MAP thresholds was conducted. The classification scale and the classes boundaries are defined based on the data set variability. Macro litter on beaches and on the Seafloor were classified following a 5-class scheme along a scale from 0 items counts to 5 times the threshold value. For floating microplastics the increased variability of the data has led to 6 classes scheme along a wide classification scale from 0 counts up to 1000 times the threshold value.

Table 1. Basic methodological principles of environmental quality status assessment methods and tools.

Assessment tool	**Data treatment**	**Comparison to threshold GES-nGES**	**Status classes**	**Assessment area**	**Aggregation method for a given area** (grid, subSAU, station)	**Spatial integration method for larger areas**
CHASE+ For contaminants	No	CR ratio to TV (0- >10)	HIGH 0.0 < CR/CS ≤0.5 GOOD 0.5< CR/CS ≤ 1.0 MODERATE 1.0< CR/CS ≤ 5.0 POOR 5.0 < CR/CS ≤ 10.0 BAD CR/CS > 10.0	Rectangular Grid cells 20x20 km or 100 x 100 km	Square root average (CS) calculated for all contaminants per matrix (water, seds, biota). Max CS for a given matrix determines overall status of grid area (OAOA principle)	–
NEAT	Log 10 transformation	NEAT score normalized ratio to TV (0-1)	HIGH 1.0 ≥ EQR > 0.8 GOOD 0.8 ≥ EQR > 0.6 MODERATE 0.6 ≥ EQR > 0.4 POOR 0.4 ≥ EQR> 0.2 BAD 0.2 ≥ EQR > 0	Geographical areas (subSAUs and SAUs)	Average NEAT score for all parameters measured on the subSAU level, either per matrix or overall	Weighted average based on subSAU/ SAU area and position in the nested scheme
MALT For marine litter	Log10 transformation	EQR normalized ratio (0-1)	HIGH 1.0 ≥ EQR > 0.8 GOOD 0.8 ≥ EQR > 0.6 MODERATE 0.6 ≥ EQR > 0.4 POOR 0.4 ≥ EQR> 0.2 BAD 0.2 ≥ EQR > 0	Rectangular Grid cells 20x20 km or 100 x 100 km	Average EQR for each litter type per grid area (i.e. ave Macro in beaches and seafloor, ave Micro in beaches and seasurface) Min EQR determines overall status of grid area (OAOA principle)	–
IMAP simplified CHASE+ For Beach & Seafloor Macrolitter	No	CR ratio to TV (0- >5)	HIGH 0.0 < CR ≤0.5 GOOD 0.5< CR ≤ 1.0 MODERATE 1.0< CR ≤ 2.0 POOR 2.0 < CR ≤ 5.0 BAD CR > 5.0	Monitoring stations	Average CR for each litter type per station	–
IMAP simplified CHASE+ For Floating microplastics	No	CR ratio to TV (0- >1000)	HIGH 0.0 < CR ≤0.5 GOOD 0.5< CR ≤ 1.0 MODERATE 1.0< CR 100 POOR 10 < CR ≤ 100 BAD 100 < CR ≤ 1000 VERY BAD CR > 1000	Monitoring stations	Average CR for each litter type per station	–

References

Andersen JH, Caetano M, Grouhel-Pellouin A, Harvey ET, Reker J and Murray CJ (2022) Mapping of contamination problem areas in Europe's seas using a multi-metric indicator-based assessment tool. Front. Mar. Sci. 9:1037914. doi: 10.3389/fmars.2022.1037914

Andersen, J.H., Murray, C., Larsen, M.M., Green, N., Høgåsen, T., Dahlgren, E., Garnaga-Budrė, G., Gustavson, K., Haarich, M., Kallenbach, E.M.F., Mannio, J., Strand, J. and Korpinen, S. (2016) Development and testing of a prototype tool for integrated assessment of chemical status in marine environments. Environmental Monitoring and Assessment 188(2), 115.

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

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

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

Borja, A., I. Menchaca, J. M. Garmendia, J. Franco, J. Larreta, Y. Sagarminaga, Y. Schembri, R. González, R. Antón, T. Micallef, S. Camilleri, O. Solaun, A. Uriarte, M. C. Uyarra, 2021. Big Insights From a Small Country: The Added Value of Integrated Assessment in the Marine Environmental Status Evaluation of Malta. Frontiers in Marine Science, 8: 10.3389/fmars.2021.638232.

Borja, A., J. M. Garmendia, I. Menchaca, A. Uriarte, Y. Sagarmínaga, 2019. Yes, We Can! Large-Scale Integrative Assessment of European Regional Seas, Using Open Access Databases. Frontiers in Marine Science, 6: 10.3389/fmars.2019.00019.

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

EEA (2019b) Marine messages II. Navigating the course towards clean, healthy and productive seas through implementation of an ecosystem-based approach. EEA Report No 17/2019

Kazanidis, G., C. Orejas, A. Borja, E. Kenchington, L.-A. Henry, O. Callery, M. Carreiro-Silva, H. Egilsdottir, E. Giacomello, A. Grehan, L. Menot, T. Morato, S. Á. Ragnarsson, J. L. Rueda, D. Stirling, T. Stratmann, D. van Oevelen, A. Palialexis, D. Johnson, J. M. Roberts, 2020. Assessing the environmental status of selected North Atlantic deep-sea ecosystems. Ecological Indicators, 119: 106624.

UNEP/MED (2023) WG.556/Inf.16 The Updated 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 Application of the NEAT GES Assessment Methodology for IMAP Common Indicators 13, 14 and 17 in the Adriatic Sea Sub-region.

UNEP/MED (2023) WG.556/Inf.6 The Updated Results of GES Assessment for IMAP Common Indicator 17 in the Adriatic Sea Sub-region by Applying the NEAT GES Assessment Methodology Harmonized with the CHASE+ Environmental Assessment Methodology

UNEP/MED (2023) 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.

UNEP/MED WG.550/12 (2023) 2023 Mediterranean Quality Status Report (QSR): Marine Litter Ecological Objective (EO10).

UNEP/MED WG.556/Inf.8 (2023) The Marine Environment Assessment in the Areas with Insufficient Data: The Updated Results of GES Assessment for IMAP Common Indicator 17 in the Levantine

Sea Basin by Applying the CHASE+ Environmental Assessment Methodology Harmonized with the NEAT GES Assessment Methodology

Veiga, J.M., Winterstetter, A., Murray, C., Šubelj, G., Birk, S., Lusher, A., van Bavel, B., Aytan, Ü., Andersen, J.H., Sholokhova, A., Kideys, A., Smit, M.J., Arnold and M., Aydın, M., 2022, Marine litter in Europe – An integrated assessment from source to sea. ETC/ICM Technical Report 05/2022: European Topic Centre on Inland, Coastal and Marine Waters, 198 pp.