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Joint Meeting of the Ecosystem Approach Correspondence Groups on Pollution and Marine Litter Monitoring

Anavyssos, Greece, 27 -28 May 2025

Report of the Meeting

UNEP/MAP
Athens, 2025

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Introduction

1. In accordance with Decision IG.26/14 on "UNEP/MAP Programme of Work and Budget for the biennium 2024 – 2025", and Decision IG.26/3 on "The 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean", as adopted by the 23rd Ordinary Meeting of the Contracting Parties to the Barcelona Convention and its Protocols, Portoroz, Slovenia, 5-8 December 2023, including the revision of the Ecosystem Approach (EcAp) and the enhancement of IMAP, UNEP/MAP, at the kind invitation and hosting of the Hellenic Centre for Marine Research (HCMR), organized the Joint Meeting of the Ecosystem Approach Correspondence Groups on Pollution and Marine Litter Monitoring. The Meeting was held in Anavyssos, Greece, on 27-28 May 2025.

2. The objectives of the Joint Meeting of CORMONs, were to:

a) Review the proposal related to GES definition and Targets for pollution litter cluster including the governance mechanism and flow of interaction for the implementation of EcAp, with a particular focus on the mandate of the CORMONs.
b) Review the proposed update of the Integrated Monitoring and Assessment Programme (IMAP) for the Mediterranean, for EOs 5, 9, 10, and 11;
c) Review the proposed updated Guidance Factsheets for IMAP Pollution Indicators;
d) Review the proposed updated Proposal for Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24;

Agenda item 1: Opening of the Meeting

3. On behalf of UNEP/MAP, the Meeting was opened by Ms. Olfat Hamdan, Programme Management Officer of the Mediterranean Pollution Assessment and Control Programme (MED POL). She provided an overview of the meeting agenda and organizational matters, including a proposal for the election of the meeting officers. Ms. Hamdan emphasized the importance of the meeting's outcomes in the context of the ongoing revision of the Integrated Monitoring and Assessment Programme (IMAP) of UNEP/MAP. Following her remarks, Mr. Faraj El Awar, the newly appointed Senior Programme Officer who will be heading MED POL and QSR at UNEP-MAP, was introduced to the participants.

4. On behalf of the Hellenic Centre for Marine Research (HCMR), the host institution of the Joint CorMon Meeting, Mr. Aris Karageorgis, President of HCMR, welcomed the participants. He introduced the institutional, human, and technical capacities of HCMR, highlighting its facilities in Crete and Rhodes, as well as the construction of a new HCMR building in Anavyssos and plan to purchase a new research vessel. This was followed by a presentation of HCMR's scientific and programmatic work, considering the framework of UNEP's ongoing efforts to address the triple planetary crisis.

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

6. 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

7. 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

8. In accordance with the Rules of procedures for meetings and conferences of the Contracting Parties, the Meeting elected one (1) President, two (2) Vice-Presidents and one (1) Rapporteur from among the participants, as follows:

Chair: Greece, Ms. Kalliopi Pagkou
Vice-Chair: Libya, Mr. Saleh Diryak,
Vice-Chair: Montenegro, Ms. Ivana Mitrovic
Rapporteur: Lebanon, Mr. Milad Fakhry

c) Adoption of the Provisional Agenda

9. The proposed Provisional agenda appearing in document UNEP/MED WG.626/2, was adopted without changes.

d) Organization of Work

10. Discussions were held in plenary sessions, as follows:
(a) 27 May 2025: from 09:30 to 12:30, and from 14:30 to 17:30
(b) 28 May 2025: from 09:30 to 12:30, and from 14:30 to 17:30

11. A visit to the HCMR premises and laboratories was organized for the Meeting Participants during the lunch break of both days (i.e., 27 and 28 May 2025).

12. A visit to Cape Sounion and the Temple of Poseidon was organized by HCMR on 28 May 2025, immediately after the Meeting.

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

Agenda item 3: IMAP Update
a. IMAP Pollution Ecological Objectives and Indicators
b. IMAP Marine Litter Ecological Objective and Indicators

14. Ms. Jelena Knežević, Monitoring and Assessment Officer at UNEP/MAP – MED POL, presented **Working Document WG.626/3/Rev.1**. She explained that, in line with Decision IG.26/14 (COP 23, 2023) and the mandate on the EcAp Roadmap and IMAP revision, the Secretariat and MED POL prepared a draft to update Operational Objectives, IMAP Common Indicators, GES definitions, and Targets for EO 5 (Eutrophication) and EO 9 (Pollution). The proposal was first presented at the CorMon Pollution online meeting on 30 January 2025, where the establishment of an Online Working Group was agreed. This group finalized Annex I of WG.602/3 for submission to the MED POL Focal Points Meeting in June 2025, as noted in the Meeting report (UNEP MED WG.602/4). Following a careful review of the agreed document by the Online Working Group, the Secretariat identified minor adjustments needed to align fully with relevant decisions, especially regarding certain GES targets. Therefore, document WG.626/3/Rev.1 replaces the previously circulated version.

15. Following the introductory remarks, the Secretariat - MED POL presented the proposed revisions to the targets for IMAP Common Indicators 13 and 14 (EO 5 – Eutrophication), Common Indicators 17, 18, 20, and 21 (EO 9 – Contaminants), and Candidate Common Indicators 26 and 27 (EO 11 – Underwater Noise), as outlined in Tables 1 and 2 of the **Working Document WG.626/3/Rev.1**. She explained revision for every Common Indicator in detail using the Working Document UNEP/MED WG.626/3/Rev.1, which was displayed on the screen. It emphasized key

achievements from 2019–2023 set the ground for the revised targets in order to ensure their alignment with GES/non-GES classifications used in the 2023 Mediterranean Quality Status Report (2023 MED QSR). She emphasized that the current document proposes upgrading Candidate Common Indicators 26 and 27 to IMAP Common Indicators, reflecting major progress in underwater noise assessment. This includes the 2023 MED QSR noise assessment, based on the framework from the 2019 MED POL Focal Points Meeting's Guidance Factsheet, further refined with evolving scientific knowledge and presented in document UNEP/MED WG.626/5/Rev.1.

16. Mr. Christos Ioakeimidis, QSR Programme Management Officer at UNEP/MAP, proceeded to introduce **Working Document WG.626/6** “IMAP Update for Ecological Objective 10”. He provided detailed explanation on the proposed revisions under IMAP EO10, including the new indicator on riverine litter and the upgrade of Candidate Indicator 24 to Common Indicator. Explicit reference and review took place for the indicators, GES definitions and targets as outlined in Table 2 of Working Document WG.626/6.

17. Following the introductory remarks, **Working Documents UNEP/MED WG.626/3/Rev 1 and UNEP/MED WG.626/6** were displayed one by one on the screen for review and comment by the meeting participants.

18. Regarding **Working Documents UNEP/MED WG.626/3/Rev.1**, several meeting participants expressed concerns about elevating the status of the candidate to common for Indicators 26 and 27.

19. Following the request of the representative of France, who was unable to attend the meeting, the Secretariat - MED POL conveyed her country's questions and proposed amendments to document WG.626/3/Rev.1, along with the corresponding responses from the Secretariat for the consideration of the Meeting.

20. One country reported that it is currently piloting candidate Common Indicator 26 (cCI 26) and facing several challenges related to threshold values and modelling approaches. As for candidate Common Indicator 27 (cCI 27), it is newly introduced and lacks sufficient implementation experience. Consequently, the Secretariat – MED POL was advised to initiate a project aimed at providing technical assistance for noise monitoring and assessment. This perspective was supported by another participant, who raised concerns about the IMAP framework requiring a higher frequency of noise monitoring compared to the MSFD. The participant highlighted the challenges in noise modelling, particularly in the application of LOBE concept.

21. One meeting participant expressed a contrary opinion, suggesting that, given the extensive knowledge accumulated over the past few years, noise monitoring could begin with modelling, and then be further advanced with support from UNEP/MAP.

22. Another participant, seconded by a colleague, proposed incorporating new biological parameters into monitoring efforts, specifically related to algal blooms, including their frequency and toxicity, as part of the assessment of the marine environment with reference to Chlorophyll *a*.

23. Two participants expressed concern about maintaining the correlation of turbidity, transparency, and dissolved oxygen concentration with the monitoring and assessment of Chlorophyll *a*. They noted that these parameters are rarely reported under the MSFD and requested clarification on whether the dissolved oxygen also includes concentrations near the seabed. Another participant opined that the lower parts of the water column are less affected by anthropogenic impacts compared to surface layers. In this context, they suggested that the original target referring to dissolved oxygen concentration above the local threshold should instead refer to values below the threshold.

24. One participant requested a clear definition of "high-risk areas."

25. Another participant proposed a revised definition for Good Environmental Status (GES) under IMAP Common Indicator 18, suggesting it be decoupled from acute pollution events typically associated with Common Indicator 19. This was followed by an agreement of the Meeting to rephrase the target as follows**:** "Concentrations of contaminants are not giving rise to negative effects on the health status of marine biota." The proposed rewording better reflects the key aspect of marine organism health rather than acute pollution.

26. With respect to the target for Common Indicator 17, a few rewording suggestions were made, particularly concerning the phrase "deterioration trend." There was an agreement of the Meeting reached to replace it with the term: "no increasing trends" in contaminant concentrations in sediments and biota from human-impacted areas. This rewording enhances the accuracy of the GES target.

27. In response to the questions and proposals raised by several participants, the Secretariat – MED POL provided clarifications on various topics. She explained the collaborative work with ACCOBAMS on noise monitoring and assessment, emphasizing the science–policy interface component, which is being addressed by UNEP/MAP – MED POL.

28. Regarding algal blooms and their toxic impacts, the Secretariat – MED POL noted that these biological parameters responsible for key differences in EO5 monitoring between the MSFD and IMAP are rightly reflected in the current proposals. However, she emphasized the need to assess the capacity of countries to expand the current scope of eutrophication monitoring to include the biological parameters. These were initially excluded from IMAP due to limited national capacities. Given the state of data reporting for existing parameters over the past five years, it is unlikely that the situation will improve significantly. She also stated that any changes to GES (Good Environmental Status) targets and definitions in the current revision should remain minimal, maintaining alignment with those originally set in 2012, 2013, and 2016.

29. The ongoing revisions aim to retain targets for turbidity, water transparency, and dissolved oxygen concentrations, ensuring consistency with the GES definition for Common Indicator 14 on Chlorophyll-a: "Natural levels of algal biomass, water transparency, and oxygen concentrations in line with prevailing physiographic, geographic, and weather conditions." The revised current document revisits the original GES definitions, which identified turbidity, water transparency, and dissolved oxygen as supporting parameters for assessing GES based on chlorophyll-a concentrations. This approach also promotes alignment between IMAP and MSFD.

30. The Secretariat – MED POL further clarified that the 2012 EcAp indicator list included both dissolved and bottom oxygen. However, with the subsequent development of IMAP indicators, dissolved oxygen concentration has been defined as a mandatory sub-indicator, and the monitoring guidelines specify the depths at which this indicator is to be measured—including near the bottom. Despite this, only surface oxygen data have been partially available for assessment within the 2023 MED QSR and are thus used in the eutrophication evaluation.

31. Any IMAP and EcAp related documents do not define high-risk areas, so no further detail can be provided at this stage.

32. Following the discussion on Working Document UNEP/MED WG.626/3/Rev.1, "MAP Update for Ecological Objectives 5, 9 and 11," the Meeting endorsed the submission of the updated Ecological Objectives 5, 9, and 11, as presented in Appendix I to the conclusions and recommendations, to the MED POL Focal Points Meeting (17–19 June 2025).

33. Regarding **Working Documents UNEP/MED WG.626/6** for Ecological Objective 10, a number of Contracting Parties took the floor to express appreciation on the work conducted by the Secretariat and the CORMON Meeting on Marine Litter Monitoring (29 January 2025) to support the update of IMAP EO10 and endorsed the new/upgraded Common Indicators.

34. Representatives of Contracting Parties provided the following proposals to amend the text:
a) The inclusion of refences on mesoplastic and pellets on beaches;
b) Extensive revision of the indicator name as well as on GES definitions and targets for IMAP Common Indicator 24 under the rational of clearly distinguishing ingestion from entanglement;
c) Proposed the numbering of the new Indicator on riverine litter as "Common Indicator 28".

35. In response, relevant references were included in paragraph 14 of Working Document WG.626/6, and in its table 2, a new indicator name was reflected for Common Indicator 24, and the respective GES definitions and targets were formulated for ingestion and entanglement, as reflected in Appendix 2 of the Conclusions and Recommendations.

36. The Meeting endorsed the updated version of Working Document WG.626/6, as reflected in Appendix 2 of the Conclusions and Recommendations, for submission to the Meeting of the MED POL Focal Points (17-19 June 2025).

37. The Secretariat – MED POL presented **Working Document WG.626/9**, explaining that it updates the *Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP)*, originally adopted by Decision IG.22/7 of COP 19. The updates reflect developments within the UNEP/MAP Barcelona Convention framework since 2016 and focus on the Pollution and Litter components—Ecological Objectives (EO) 5, 9, 10, and 11. An initial revision effort appeared in Document UNEP/MED WG.595/Inf.4, prepared for the 11th Meeting of the Ecosystem Approach Coordination Group (EcAp CG), held online on 2 October 2024. The current updates incorporate decisions made by the Contracting Parties (via EcAp CG, MAP, and COP) on methodologies and assessment criteria, which were applied during the preparation of the 2023 Mediterranean Quality Status Report (2023 MED QSR).

38. Referring to the on-screen document, she presented the updates to EO 5, 9, and 11, highlighting their alignment with revised targets for Common Indicators related to eutrophication, contaminants, and noise, as outlined in Working Document UNEP/MED WG.626/3/Rev.1. She also referred to a few corrections included in Annex I, providing the assessment criteria as approved by COP 23 (Decision IG.26/3). The document also proposes a new Marine Litter Indicator (CI23 bis) and the elevation of candidate Indicators 24, 26, and 27—concerning impulsive and continuous noise—to the status of Common Indicators.

39. **Regarding the section on EO5**, one meeting representative proposed adding a point to paragraph 4 to ensure consistency among international data sources. For example, it was suggested that a system aligning the use of both IMAP and EMODnet should be proposed to better coordinate the use of international data. Another participant, supported by two others, requested clarification of the phrase *"monitoring and conducting GES assessments at national, sub-regional, and regional levels."* They proposed distinguishing more clearly between assessments conducted at the national level and those carried out at the sub-regional and regional levels.

40. In response to the proposals, the Secretariat – MED POL clarified that "conducting assessments" primarily refers to the exchange of experiences and capacity-building efforts at all levels. She emphasized that sub-regional and regional assessments rely on national data, with ownership resting with the respective countries. To address the proposal put forward by a few meeting participants, she suggested additional wording to paragraph 17. Accordingly, the meeting agreed on the revised text for paragraph 17, which refers to exchange of experiences and strengthening national capacities by the Contracting Parties regarding monitoring, and conducting GES assessments at national level, while they should also contribute to sub-regional and regional efforts.

41. Regarding the harmonization of international data sources, instead of revising the wording in paragraph 3, the Meeting found it more appropriate to amend paragraph 16 by explaining that data reporting should be supported through greater harmonization of diverse data management systems at the international level.

42. **Regarding the section on EO9**, one participant noted that excluding Environmental Assessment Criteria (EACs) from Good Environmental Status (GES) assessments could be problematic. While EACs are not perfect, their complete omission is not a viable option. Background Assessment Criteria (BACs) do not reflect the toxicity of various contaminants. Therefore, alternative approaches should be considered. To distinguish between GES and non-GES, assessments must be based on toxicity—i.e., actual impacts on marine organisms. He suggested a proportional use of EACs, with EAC values serving as upper thresholds, rather than relying solely on proportional use of BACs.

43. Another participant emphasized that incorporating toxicity into assessments is a distinct and complex issue. BACs can serve as a starting point for GES assessments, provided toxicity considerations are not excluded. Given varying laboratory capacities, there is no current plan to mandate detailed toxicity data. Replacing GES/non-GES classification with an evaluation of contaminant accumulation could be an alternative.

44. A third participant highlighted that the Bathing Water Directive is more stringent than IMAP, relying on two main parameters. Greater synergy between these frameworks is needed. This was noted as a general observation on bathing water, and support was expressed for the wording in paragraph 28.

45. In response to the proposals, the Secretariat – MED POL clarified that proportional use of BACs is currently the only feasible approach, though not ideal. EACs are not viable due to their high values, and scaling assessments based on them does not yield meaningful environmental results. Moreover, the use of existing EACs lacks justification, as they are not derived from ecotoxicity assessments specific to Mediterranean species. Therefore, the Secretariat – MED POL applied proportional BAC values and assessed their potential alignment with future, Mediterranean-relevant EACs. The IMAP Guidance Factsheets and 2023 MED QSR classification system are based on proportional BAC values, but the use of EACs remains valid. The 2023 MED QSR Decision supports continued efforts to develop Mediterranean-specific EACs. To advance this, the Secretariat – MED POL proposed forming three Working Groups—on eutrophication, contaminants, and biological effects—to compile scientific databases from existing literature. As IMAP does not mandate ecotoxicity data reporting, progress depends on active support from the Contracting Parties. Paragraph 33 of the current document includes both BACs and EACs as GES assessment criteria, with neither excluded.

46. The Secretariat – MED POL stressed that language approved by the COP cannot be altered to replace GES criteria with those based solely on contaminant accumulation. However, revisions of the wording in the IMAP Guidance Factsheet may address concerns without modifying the current document on Ecological Objectives.

47. Finally, the overall assessment methodology was designed to align with bathing water quality assessment practices. By applying the "one out – all out" principle, inconsistencies between the Bathing Water Directive and IMAP assessments were resolved.

48. Referring to the on-screen document, the Secretariat presented the **updates to IMAP EO 10**, highlighting their alignment with the content of the revised Working Document UNEP/MED WG.626/6 (Appendix 2 of the Conclusions and Recommendations).

49. In alignment with the revisions reflected in Working Document UNEP/MED WG.626/6, representatives of Contracting Parties took the floor and proposed to:

a) Include refences on mesoplastic and pellets on beaches;
b) Revise the name of Common Indicator 24;
c) Proposed the numbering of the new Indicator on riverine litter as "Common Indicator 28".

50. Special reference was made to Annex I – Part II of the **Working Document WG.626/9,** reflecting the Baseline Values (BV) and Threshold Values (TV) for IMAP EO10 Common Indicators, in particular for the new/updated values for Common Indicator 24.

51. **Regarding the section on EO11**, further to the discussion on the status of noise-related indicators within the context of WG.626/3/Rev.1, one meeting participant noted challenges in noise monitoring from building and military activities, as this may require data from various companies. He proposed removing references to these sources. Another representative questioned whether noise should be included in national monitoring programmes, pointing out that this would create a regular obligation for countries, which is unfeasible without technical assistance and adequate equipment.

52. In response, the Secretariat – MED POL explained that noise monitoring involves collecting data from multiple sources, including military activities, as was done for the 2023 MED QSR. Access to such data is governed by national procedures and relevant regulations. Revisions to the wording can be eventually considered by reviewing the IMAP Guidance Factsheets (WG.626/5/Rev.1). To address concerns about mandatory implementation of noise monitoring, and considering the Meeting's decision to retain both indicators as candidates, the Secretariat – MED POL proposed amending paragraph 61 to state that countries should "consider" including Candidate Common Indicators 26 and 27 in their national IMAP-based monitoring programmes.

53. The Secretariat – MED POL also presented corrections in Annex I of the current document, containing the assessment criteria as approved by COP 23 (Decision IG.26/3). These include minor changes—to the second decimal place of Reference Conditions (RC) and Boundary Values (BV) for Chlorophyll-a (Chl-a) in water types II A FR SP and III W FR SP, based on one country's proposal. Gmean values for the 90th percentile of RC and BV for these types were added at another country's request. These explanations were followed by the Meeting's approval of the proposed corrections.

54. The Meeting endorsed the updated version of Working Document WG.626/9, as reflected in Appendix 3 of the Conclusions and Recommendations, for submission to the Meeting of the MED POL Focal Points (17-19 June 2025).

Agenda item 4: Guidance Factsheets for IMAP Pollution Indicators.

55. The Secretariat – MED POL presented **Working Document WG.626/4/Rev.1** on the updated Guidance Factsheets for IMAP Common Indicators 13, 14, 17, 18, 20, and 21. She recalled that, in alignment with IMAP, initial Guidance Factsheets for Pollution Common Indicators were developed, reviewed, and endorsed in 2016 and 2017, following Decisions IG.22/7 (COP 19, 2016) and IG.23/6 (COP 20, 2017). In 2019, these Factsheets were updated for Indicators 13, 14, 17, 18, 20, and 21. Initial Factsheets were also developed for Candidate Indicators 26 and 27 under Ecological Objective 11 (Energy, including underwater noise). Pursuant to Decision IG.24/4 on Assessment Studies, monitoring and assessment tools, practices, and standards were developed, as outlined in the 2023 MED QSR roadmap and needs assessment. Building on progress since 2019, the 2023 MED QSR was adopted by Decision IG.26/3 (COP 23, 2023). Additionally, Decision IG.26/14 (COP 23, 2023) on the Programme of Work and Budget for 2024–2025 mandated MED POL to deliver "e) IMAP pollution and marine Cluster CIs Guidance" under activity 6.2.2. The present document does not include the revised GES definitions and targets per indicator, as these must first be agreed upon in Meeting Document WG.626/4/Rev.1, and subsequently integrated into the Guidance Factsheets.

56. Referring to the on-screen document, she presented one by one the updates for Common Indicators 13, 14, 17, 18, 20, and 21, providing explanations for each and linking them to the achievements reviewed and agreed upon for the preparation of the 2023 MED QSR. At the request of the representative of France, who was unable to attend the meeting, she also conveyed her country's questions and proposed amendments to the current document, along with the corresponding responses from the Secretariat, for the Meeting's consideration.

57. **Following the introduction of Common Indicators 13 and 14 (CIs 13 and 14)**, and at France's request, the Secretariat – MED POL presented French experts' views on using satellite-derived chlorophyll-a (Chl-a) data in France. These data, calibrated with *in situ* measurements, do not represent the wider Mediterranean context. It was clarified that satellite-derived Chl-a is neither mandatory nor voluntary under IMAP and was used in the 2023 MED QSR as a practical substitute due to missing IMAP data. Differences between *in situ* and satellite data were explained, including the lack of inter-calibration across the region. Procedures for threshold calculation were outlined, with proposed amendments to the "Scale of Simplified Assessment of Chlorophyll-a (IMAP Common Indicator 14)" in the Guidance Factsheets.

58. Taking into account the proposal of another meeting participant, which complemented the proposal of France, an addition was made to recognize satellite-derived Chl-a as a supplementary parameter. The amendment emphasizes the need for statistical calculation of assessment criteria based on satellite data in the absence *of in situ* data, particularly in cases where Contracting Parties have not reported a proven relationship between *in situ* Chl-a and satellite-derived data. The amended text also includes consideration of scientifically justified national findings in cases of discrepancies between regional assessments based on satellite-derived data and national assessments using *in situ* data and country-specific scales.

59. Following the explanation of the corrections in Annex I of Working Document WG.626/9, the Secretariat – MED POL provided further technical clarification on minor adjustments to Reference Conditions (RC) and Boundary Values (BV) for Chlorophyll-a (Chl-a) in water types II A FR SP and III W FR SP, as reflected in the Assessment Criteria section of the IMAP Guidance Factsheets. The Meeting subsequently approved the proposed corrections in WG.626/4/Rev.1 and Annex I of WG.626/9.

60. One participant supported the supplementary use of satellite-derived data not only for chlorophyll-a but also for other physic-chemical parameters, especially in marine areas lacking *in-situ* coverage. He also mentioned the use of arithmetic mean modelling as an alternative and requested information from the Secretariat on the consideration of this technology. Another participant stressed the necessity of calibrating satellite-derived data with *in-situ* data, particularly in coastal waters.

61. The Secretariat – MED POL explained that IMAP Info System data were not correlated with satellite-derived data used from various sources for the 2023 MED QSR, considering different scope of these sources regarding both temporal and spatial aspects. While inter-calibration with *in-situ* data is ensured by satellite data producers through quality control procedures—rendering them pre-calibrated—they are not equated with *in-situ* IMAP data. Instead, assessment criteria were calculated from satellite-derived data. If funding allows, arithmetic mean modelling could be used to enhance monitoring.

62. Responding to concerns about assessment methodologies, the Secretariat – MED POL clarified that IMAP Guidance Factsheets do not state that current methods are fixed, and future revisions are possible. Another participant noted differing chlorophyll-a values for Type III E waters in Malta under development at the EU level, which may be addressed within IMAP during the upcoming review of values within the next two to three years.

63. A participant suggested expanding assessment criteria to include other parameters like orthophosphates. The Secretariat clarified that while the 2021 and 2022 CorMons conclusions require criteria for Chlorophyll a, TP, and DIN as a minimum, they do not restrict developing criteria for other parameters if data are available.

64. **Following the introduction of Common Indicator 17 (CI 17),** and at France's request, the Secretariat presented the views of French experts on assessment criteria for contaminants and their units of measurement. In response to the proposals, the Secretariat clarified that the IMAP Guidance Factsheet for CI 17 introduces no new developments in assessment criteria, methodologies, scales, or

monitoring practices beyond those agreed upon by all Contracting Parties for the 2023 MED QSR. While national processes are acknowledged, a clear distinction exists between regional and national values and considerations. Most of threshold values are expressed in dry weight, in accordance with the IMAP Decision and the MSFD (in sediment matrix), reflecting also the fact that most national datasets report contaminant concentrations in dry weight without providing a dry/wet weight conversion factor. Several literature sources were added in IMAP Guidance Factsheet due to their relevance to those already included, and their contribution to supporting progress as of 2016.

65. One participant raised concerns about several points already discussed and agreed by the CorMons in 2021 and 2022. These included the definition of Background Concentrations (BCs) and Background Assessment Concentrations (BACs), established in 2012, 2016, and most recently in 2022; the application of regional values of Environmental Assessment Criteria (EACs) at the sub-regional levels; the lack of alignment between GES/non-GES classification and ecotoxicity and the use of concentrations below detection limits for calculation of assessment criteria. He also proposed replacing the term “emerging contaminants” with “contaminants of emerging concern,” explaining that many of these contaminants have been used and released into the environment for a long time, while concerns about their effects and on need for regulation have begun to emerge. Another participant opposed the inclusion of new contaminants in the mandatory IMAP list.

66. In response, the Secretariat – MED POL explained that the calculation of sub-regional BACs is necessary to account for specific ecosystem characteristics, and their influence on local contaminant dynamics. This is essential to avoid biased assessments. She also clarified that the consideration of non-traditional contaminants relates to data collection on their ecotoxicity, not to expanding the mandatory list. To reflect the importance of ecotoxicity, an addition was proposed and agreed upon in the section on Known Gaps, stating that further efforts are needed to ensure the revised Environmental Assessment Criteria integrate toxicity considerations into future GES/non-GES assessments. It was also noted that, in addition to traditional contaminants, the optional inclusion of other environmental contaminants should be considered for setting the thresholds based in ecotoxicity.

67. Another participant referred to the species currently agreed upon as biota matrices for pollutant monitoring. She noted that in her country, GES cannot be assessed using these species and requested that other species be considered for the next QSR analysis. She also raised concerns about eutrophication, noting that measuring Total Phosphorus (TP) is very difficult, and suggested that inorganic phosphorus be considered as an alternative.

68. One participant asked the Secretariat to elaborate on the use of EMODnet as a new data source. Another participant provided comments on the list of contaminants, suggesting editorial corrections related to organochlorine contaminants, and emphasized the need to define the list of individual PCB congeners that comprise the sum of PCBs.

69. In response, the Secretariat – MED POL explained that the section *Improve the GES Assessment* includes a provision for expanding the list of commonly agreed IMAP pollution indicator species. The Guidance Factsheet specifies that, in addition to the currently mandatory *Mytilus galloprovincialis* and *Mullus barbatus*, other species should be added based on their presence in the sub-regions and their relevance as pollution indicators. Harmonization in the use of different species across sub-regions is also encouraged.

70. The Secretariat – MED POL further explained inconsistencies between the Data Dictionaries and the list of mandatory contaminants adopted by the 2019 MED POL Focal Points. A question was raised regarding the retention of 9 PCB congeners, including congeners 105 and 156. The meeting agreed to retain all 9 individual PCB congeners as mandatory parameters and clarified that the sum of 7 PCBs includes congeners 28, 52, 101, 118, 138, 153, and 180. The meeting also agreed to include Copper and its compounds, as decided in 2019, which were omitted from the Data Dictionaries under CI 17. Additionally, it was agreed to list all 16 individual PAHs required to be reported as mandatory, and to specify that the sum includes all 16 compounds. It was also confirmed that the mandatory list

includes both heavy metals (Hg, Cd, Pb, and Cu) and their respective compounds, as also defined under the WFD.

71. Regarding the use of EMODnet, it was clarified that this database serves only as a supplementary data source, and only in cases where data are missing from the IMAP Info System.

72. **Regarding the sections on Common Indicators 18 (CI 18)**, the Secretariat – MED POL informed that the two countries submitted written pre-session proposals aimed at reviewing the proposed Guidance Factsheet for CI 18. Their representatives took the floor to elaborate on their proposals for the Meeting's consideration.

73. One participant presented several suggestions, including:
a) Improving the definitions of LMS (Lysosomal Membrane Stability) and AChE (Acetylcholinesterase);
b) Emphasizing that the use of biomarkers should not be exclusively limited to hotspot stations but should instead encompass a range of possible applications;
c) In addition to assessing environmental status for CI 18 using BAC (Background Assessment Criteria) and EAC (Environmental Assessment Criteria) values, supporting the assessment of effects by comparing biomarker values at monitoring stations with those measured at control sites;
d) Adding additional biomarkers to address damage, such as DNA damage;
e) Removing "% LMS – Mean percentage of Lysosomal Membrane Stability in mussel" from the list of biomarkers included in the CI 18 data dictionary;
f) Removing malondialdehyde accumulation levels (MDA) from the list of additional new indicators;
g) Including fish alongside bivalves for the monitoring of LMS and AChE;
h) Considering the need to organize intercalibration tests with partners beyond IAEA/MESL, including exploring alternative modalities such as ring tests.
i) Another participant advocated for integrating chemical and biological monitoring, emphasizing the importance of monitoring biomarkers not only in reference areas but also in hotspots and other relevant locations. This participant also called for:
j) Improved definitions of LMS and AChE;
k) Consideration of proposals for additional biomarkers based on experience from other sub-regions.

74. A third participant supported enhancing the definitions of the mandatory biomarkers LMS and AChE and recommended the inclusion of biomarkers that reflect damage responses, such as oxidative stress. She also emphasized that biomarkers should be measured in both hotspots and reference areas, and that assessments may be conducted by comparing measured values with reference values, rather than relying solely on EACs. She highlighted the importance of giving due attention to a broad range of additional biomarkers, while noting the challenges in ensuring their proper interpretation.

75. Two participants reported limited national capacity for biomarker monitoring. They called for a possible reduction in the list of mandatory species and recommended adding fish as a matrix for biomarker measurement, alongside mussels.

76. Referring to the on-screen document, the Secretariat – MED POL revised the Guidance Factsheet for Common Indicator 18 by incorporating the following revisions as agreed by the Meeting:
a) Strengthening the policy section by adding a paragraph on integrated chemical and biological monitoring;
b) Improving the definitions of AChE and LMS;
c) Revising unit definitions by including labialization time, and incorporating fish alongside bivalves for biomarker analysis;
d) Clarifying the text to explicitly refer to the use of biomarkers in reference areas, other areas, and hotspots;
e) Extending the list of additional biomarkers, and deleting one indicator from the list included in the Data Dictionary for CI 18;

f) Emphasizing the need for intercalibration tests for CI 18, including consideration of different modalities such as ring tests;
g) Revising the monitoring frequency to ensure the annual collection of both bivalves (e.g., *Mytilus galloprovincialis*) and fish (e.g., *Mullus barbatus*);
h) Adding an alternative assessment method for effects, involving comparison of biomarker values at monitoring stations with those measured at control sites monitored concurrently, and applying environmental status assessments for CI 18 using BAC and EAC values.
i) Including a few editorial corrections.

77. The Meeting also agreed on the need to amend the Data Dictionaries to reflect the inclusion of yearly sampling, as outlined in the Guidance Factsheets for CI 18, as well as including fish species (e.g., *Mullus barbatus*) alongside bivalves (e.g., *Mytilus galloprovincialis*) for biomarker analysis.

78. **Regarding the sections on Common Indicators 20 (CI 20)**, the Secretariat introduced revision of the Guidance Factsheet referring to the on-screen document.

79. One meeting participant, followed by two others, took the floor to request a revision of the units used for CI 20. The Meeting agreed with their proposal to replace the "frequency" with the following:
a) Measured concentrations expressed in mg/kg w.w. for metals, and in µg/kg w.w. for non-metals, in line with the *Data Standards for IMAP CI 20*; and
b) The percentage (%) of detected regulated contaminants* exceeding regulatory limits, calculated as a proportion of the total number of measured contaminants.

80. To reflect this change of the units, the Meeting agreed to revise definition for Common Indicator 20 by replacing the term "number" with "proportion."

81. The Secretariat – MED POL also explained that the current assessment criteria incorporate the maximum regulatory levels for the contaminants in foodstuffs, as established in EU legislation available in 2023, to ensure the protection of human health. Given the evolving nature of assessment criteria, their further revision will reflect the latest developments at the EU level.

82. **Regarding the sections on Common Indicators 21 (CI 21)**, the Secretariat – MED POL introduced revision of the Guidance Factsheet referring to the on-screen document.

83. Two meeting participants took the floor to propose a revision, suggesting that the phrase "the summer season focusing on the touristic beaches" be replaced with "bathing seasons."

84. One participant further proposed amending the wording regarding the minimum of four samples per season by adding the phrase: "with the interval between samplings not exceeding one month."

85. Following the Meeting's agreement on the proposed revisions, the Secretariat introduced the corresponding changes to the on-screen document.

86. The Meeting endorsed the revised version of Working Document WG.626/4/Rev.1, as presented in Appendix 4 of the Conclusions and Recommendations, for submission to the Meeting of the MED POL Focal Points (17–19 June 2025) under the no-objection procedure.

87. The Secretariat – MED POL presented **Working Document WG.626/5/Rev.1** on the updated Guidance Factsheets for IMAP Candidate Common Indicators 26 and 27. She explained that the present document outlines the revision of noise monitoring and assessment, incorporating achievements in monitoring and assessment methodologies, as approved for the preparation of the 2023 MED QSR. This document did not include targets for IMAP Candidate Common Indicators 26 and 27, as their minor adjustments, along with the proposed GES definitions, were included in working document UNEP/MED WG.626/3/Rev.1 for further consideration at the current meeting.

88. Referring to the on-screen document, the Secretariat – MED POL presented one by one the updates for **Candidate Common Indicators 26 and 27 (cCIs 26 and 27)**, providing explanations for each and linking them to the achievements reviewed and agreed upon for the preparation of the 2023 MED QSR. At the request of the representative of France, who was unable to attend the meeting, she also conveyed her country's questions and proposed amendments to the current document, along with the corresponding responses from the Secretariat, for the Meeting's consideration. She also suggested a correction to the one source used, following a proposal made by another meeting participant.

89. Except for the views expressed on noise monitoring during the discussions on WG.626/3/Rev.1 and WG.626/4/Rev.1, no additional proposals were made regarding the review of the Guidance Factsheets. Consequently, the Meeting endorsed the revised version of Working Document WG.626/5/Rev.1, as presented in Appendix 5 of the Conclusions and Recommendations, for submission to the Meeting of the MED POL Focal Points (17–19 June 2025) under the no-objection procedure.

Agenda item 5: Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24

90. Under this agenda item, the Secretariat presented Working Document UNEP/MED WG.626/7 "Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24", in particular for ingestion and entanglement on marine turtles.

91. A number of representatives of the Contracting Parties, took the floor, welcomed the updated version of the document and requested a number of changes, in particular on the section on entanglement, under the overall guidance of the already established Online Working Group (OWG):

a) To double check the number of data included in Table 1, improve the wording for the Frequency of Occurrence (FO) and split the table for ingestion and entanglement;
b) To retain the approach used for ingestion to exclude individuals with zero stomach content in the calculation of TV;
c) To use the 15th percentile approach for entanglement applied to the total number of samples; and
d) To add an explicit reference in the document that the resulted values will be subject to update for the next iteration of the Mediterranean Quality Status Report (MED QSR).

92. In response the Secretariat provided a number of clarifications and committed to prepare an updated version of the BVs and TVs for Common Indicator 24 for submission to the Meeting of the MED POL Focal Points (17-19 June 2025).

Agenda item 6: Terms of Reference and Flow of Interaction for the Correspondence Groups on Monitoring and Online Working Groups

93. Under this agenda item, the Secretariat presented Working Document UNEP/MED WG.626/8 "Terms of Reference and Flow of Interaction for the Correspondence Groups on Monitoring and Online Working Groups", with an emphasis on the sections relevant to the CORMONs mandate.

94. A number of representatives of Contracting Parties took the floor, welcomed and endorsed the possible products and proposed interaction between EcAp governing bodies, and in particular for the CORMONs.

95. The Meeting endorsed the submission of Working Document UNEP/MED WG.626/8 to the Meeting of the MED POL Focal Points (17-19 June 2025) for review and further integration in the draft Decision on EcAp (i.e. as an annex), to be subsequently submitted to the 12th Meeting of the Ecosystem Approach Coordination Group (EcAp CG) (15 Sept. 2025), as well as the Meeting of the MAP Focal Points (16-19 Sept. 2025) and COP24 (2-5 Dec. 2025).

Agenda item 7: Any Other Business

96. Under this agenda item, Mr. Malek Smaoui, Programme Officer (OPRC) at REMPEC, presented progress made in defining reporting thresholds for oil spills, as well as in proposing training activities to support the monitoring of accidental spills under Common Indicator 19 (CI 19). This information was shared with the current Meeting with the understanding that a separate technical group of Mediterranean experts, coordinated by REMPEC, will continue reviewing the specific technical details, with the aim of proposing final documents for consideration by the REMPEC Focal Points.

Agenda item 8: Conclusions and Recommendations

97. 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 9: Closure of the Meeting

98. After expressing the usual courtesies, the Chair declared the Meeting closed at 17:30 pm on Wednesday 28 May 2025.

Annex I
List of Participants

REPRESENTATIVES OF THE CONTRACTING PARTIES / REPRESENTANTS DES PARTIES CONTRACTANTES

ALBANIA/ALBANIE	**Ms. Enkeleda Shkurta** Head of Information Sector Environment Statistics and GIS **Ms. Agalliu Rovena** Ministry of Tourism and Environment **Ms. Vardhami Edit** Ministry of Tourism and Environment
BOSNIA AND HERZEGOVINA / BOSNIE ET HERZEGOVIENE	**Ms Čengić Selma** Deputy Director Hydro Engineering Institute Sarajevo **Ms. Senida Dzajic -Rghei** Hydro Engineering Institute Sarajevo **Ms. Ana Sudar** Agency for Watershed of the Adriatic Sea
CROATIA/CROATIE	**Ms. Slavica Matijević** Institute of Oceanography and Fisheries **Ms. Jelena Lusic** Institute of Oceanography and Fisheries **Ms. Mirta Smodlaka Tankovic** Ruder Boskovic Institute, Center for Marine Research
CYPRUS/CHYPRE	**Mr. Konstantinos Antoniadis** Officer of Fisheries and Marine Research
GREECE/GRECE	**Ms. Kalliopi Pagkou** Hellenic Centre for Marine Research, Institute of Oceaonography Research director **Ms. Christina Zeri** Hellenic Centre for Marine Research, Institute of Oceaonography Research director **Ms. Eleni Kaberi** Hellenic Centre for Marine Research, Institute of Oceaonography Research director **Ms. Aikaterini Tsangkari** Hellenic Centre for Marine Research, Institute of Oceaonography Research director
ISRAEL/ISRAEL	**Mr. Dror Zurel** Israel Ministry of Environmental Protection Marine Monitoring and Research Coordinator **Ms. Yael Segal** Israel Oceanographic & Limnological Research Ltd.
ITALY/ITALIE	**Mr. Marco Matiddi** Italian Institute for Environmental Protection and Research (ISPRA). **Ms. Cecilia Silvestri**

	Italian Institute for Environmental Protection and Research (ISPRA). Ms. Ginevra Moltedo Italian Institute for Environmental Protection and Research (ISPRA) Ms. Paola Guarracino Italian Institute for Environmental Protection and Research (ISPRA)
LEBANON/LIBAN	**Mr. Milad Fakhri** Director of the National Center for Marine Sciences **Ms. Celine Mahfouz** National Council for Scientific Research Lebanon (CNRS-L)
MALTA/MALTE	**Ms. Annabelle Haber** Environment & Resources Authority **Ms. Juliane Baldacchino** Assistant Environment Protection Officer
MONTENEGRO/MONTENEGRO	**Ms. Ivana.Mitrović** Advisor - Department of Nature Protection, Monitoring, Analysis and Reporting Environmental Protection Agency **Ms. Bojana Knežević** Center for Ecotoxicological Research Podgorica **Ms. Dragana Drakulović** University of Montenegro-Institute of Marine Biology
MOROCCO/MAROC	**Ms. Mariama Zbiry** INRH **Ms. Bouchra Oujidi** Department of Sustainable Development, Morocco **Mr. Abeslam Abid** LNESP/Département du Développement Durable
SPAIN /ESPAGNE	**Ms. Candela García Gómez** Spanish Institute of Oceanography **Ms. Nerea Valcarcel-Perez** Spanish Institute of Oceanography, IEO-CSIC) **Mr. Victor Leon** Instituto Español de Oceanografía (IEO-CSIC)
TUNISIA/TUNISIE	**Mr. Lassaad Chouba** Institut National des Sciences et Technologies de la Mer **Mr. Afef Fathalli** National Institute of Marine sciences and technologies **Mr. Noureddine Zaaboub** National institute of marine sciences and technologies

TURKIYE/TURKIYE	**Mr. Bahar özöğüt** Ministry of Environment Urbanization and Climate Change **Mr. Ebru Olgun Eker** Ministry of Environment Urbanization and Climate Change **Mr. Hacer Selamoğlu Çağlayan** Ministry of Environment Urbanization and Climate Change

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. Faraj El Awar** Senior Programme Officer (MED POL and QSR), UNEP E-mail: faraj.el-awar@un.org **Ms. Olfat Hamdan** MED POL Programme Management Officer E-mail: olfat.hamdan@un.org **Ms. Jelena Knezevic** MED POL Monitoring and Assessment Officer E-mail : jelena.knezevic@un.org **Mr. Christos Ioakeimidis** QSR Programme Management Officer E-mail: christos.ioakeimidis@un.org **Mr. Malek Smaoui** REMPEC Programme Officer (OPRC) E-mail : msmaoui@rempec.org **Ms. Nathalie Gomez** Programme Assistant E-mail : nathalie.gomez@un.org

**NON-GOVERNMENTAL ORGANIZATIONS /
ORGANISATIONS NON-GOUVERNEMENTALES**

HELLENIC MARINE ENVIRONMENT PROTECTION ASSOCIATION (HELMEPA)	**Mr. Stathis Kostakopoulos** **Ms. Eleni Tsolka**

**OBSERVERS/
OBSERVATEURS**

HELLENIC CENTER MARINE RESEARCH	**Ms. Aikaterini Anastasopoulou** **Ms. Ester Skylaki** **Ms. Alexandra Pavlidou** **Ms. Efthimia Cotou** **Ms. Ourania Karydi** **Mr. Elias Dimitriou**

Annex II
Agenda of the Meeting

Agenda of the Meeting

Agenda Item 1:	Opening of the Meeting
Agenda Item 2:	Organizational Matters
Agenda item 3:	IMAP Update a. IMAP Pollution Ecological Objectives and Indicators b. IMAP Marine Litter Ecological Objective and Indicators
Agenda item 4:	Guidance Factsheets for IMAP Pollution Indicators
Agenda item 5:	Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24
Agenda item 6:	Terms of Reference and Flow of Interaction for the Correspondence Groups on Monitoring and Online Working Groups
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 27-28 May 2025, the Joint Meeting of the Ecosystem Approach Correspondence Groups on Pollution and Marine Litter Monitoring was held in Anavyssos, Greece, at the kind invitation of the Hellenic Centre for Marine Research (HCMR). The Meeting was organized by UNEP/MAP Secretariat (MED POL Programme).

Further to its deliberations, the Meeting reached the following conclusions:

Agenda item 3: IMAP Update
a. IMAP Pollution Ecological Objectives and Indicators
b. IMAP Marine Litter Ecological Objective and Indicators

1. The Meeting thanked the Secretariat for organizing the Meeting and for the preparation of Working Documents.

2. Following the presentation by the Secretariat of Working Document UNEP/MED WG.626/3/Rev.1, “IMAP Update for Ecological Objectives 5, 9 and 11,” the Meeting reviewed the updated Operational Objectives, IMAP Common Indicators, Good Environmental Status (GES) definitions, and Targets for Ecological Objectives 5 (Eutrophication), 9 (Pollution), and 11 (Noise). These had been proposed by the Secretariat based on Annex I of Working Document WG.602/3 previously approved by the Online Working Group established by the Meeting of CorMon Pollution (30 January 2025). The Meeting also considered additional modifications proposed during the session. It endorsed the submission of the updated Ecological Objectives 5, 9, and 11, as presented in Appendix I to the conclusions and recommendations, to the MED POL Focal Points Meeting (17–19 June 2025). This also included agreement to enhance the monitoring and assessment of impulsive and continuous noise, while not elevating Candidate Common Indicators 26 and 27 to the status of Common Indicators.

3. Following the presentation of Working Document UNEP/MED WG.626/6, “MAP Update for Ecological Objective 10,” the Meeting reviewed the updated Operational Objectives, IMAP Common Indicators, GES definitions, and Targets for Ecological Objective 10 (Marine Litter). It endorsed the submission of the updated version, incorporating changes outlined in Appendix II to the conclusions and recommendations, to the Meeting of MED POL Focal Points to be held on 17–19 June 2025.

4. The Meeting reviewed Working Document UNEP/MED WG.626/9, “Revised Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria for Pollution and Marine Litter (EO5, EO9, EO10, EO11).” It considered the updated IMAP Common Indicators for EO5, EO9, EO10, and EO11, as proposed by the Secretariat and based on the version reviewed by the 11th Meeting of the Ecosystem Approach Coordination Group (2 October 2024), along with further modifications from participants during the session. The Meeting endorsed their submission, as outlined in Appendix III to the conclusions and recommendations, to the MED POL Focal Points Meeting (17–19 June 2025). This included an annex presenting the assessment criteria approved by COP23 (Decision IG.26/3), with an addition for Common Indicator 24 and corrections to minor errors in Common Indicator 14, based on proposals by representatives of two Contracting Parties.

5. By endorsing Working Document UNEP/MED WG.626/9, the Meeting emphasized the evolving nature of assessment criteria and the importance of their regular updates, especially for the third iteration of the Mediterranean Quality Status Report. It highlighted the need to integrate toxicity considerations into future GES/Environmental assessments. The Meeting agreed to establish online working groups tasked with reviewing scientific literature and compiling data related to nutrients, toxicity testing, occurrence of contaminants and biomarker analysis, to improve assessment criteria for eutrophication, contaminants in biota and sediments, and biomarkers.

6. Regarding the marine litter component (IMAP EO10) of Working Document UNEP/MED WG.626/9, the Meeting agreed to introduce two new Common Indicators, as follows:

a) Common Indicator 24: Trends in the amount of litter ingested by marine organisms and in the number of individuals entangled in marine litter (EO10).
b) Common Indicator 28: Trends in the amount of litter coming from riverine sources (EO10)

Agenda item 4:Guidance Factsheets for IMAP Pollution Indicators

7. The Meeting endorsed the "Updated Guidance Factsheets for IMAP Common Indicators 13, 14, 17, 18, 20, and 21" (UNEP/MED WG.626/4/Rev.1) and the "Updated Guidance Factsheets for IMAP Candidate Common Indicators 26 and 27" (UNEP/MED WG.626/5/Rev.1), as revised and presented in Appendix IV to the conclusions and recommendations, as well as their submission to the MED POL Focal Points Meeting (17–19 June 2025) for no objection. These updates reflect the modifications agreed during the meeting and ensure consistency with the revised IMAP for Ecological Objectives 5, 9, and 10 (UNEP/MED WG.626/3/Rev.1 and UNEP/MED WG.626/9).

Agenda item 5: Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24

8. The Meeting reviewed Working Document UNEP/MED WG.626/7, "Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24," and welcomed the updated version prepared by the Secretariat (MED POL and SPA/RAC) under the guidance of an Online Working Group composed of experts from France, Greece, and Italy, which improved the analysis and proposed values.

9. The Meeting requested a number of changes in the document, in particular on the section on entanglement, to incorporate the following changes [under the overall guidance of the already established OWG]:
a) Double check the number of data included in Table 1, improve the wording for the Frequency of Occurrence (FO) and split the table for ingestion and entanglement;
b) Retain the approach used for ingestion to exclude individuals with zero stomach content in the calculation of TV;
c) To use the 15th percentile approach for entanglement applied to the total number of samples;
d) Add an explicit reference in the document that the resulted values will be subject to update for the next iteration of the Mediterranean Quality Status Report.

10. The Meeting recommended the submission of the revised version of Working Document UNEP/MED WG.626/7 to the Meeting of the MED POL Focal Points (17-19 June 2025) for further review and endorsement.

Agenda item 6:Terms of Reference and Flow of Interaction for the Correspondence Groups on Monitoring and Online Working Groups

11. The Meeting reviewed Working Document UNEP/MED WG.626/8, "Terms of Reference and Flow of Interaction for the Correspondence Groups on Monitoring and Online Working Groups," with special focus to the sections concerning CORMON. It endorsed their submission to the Meeting of the MED POL Focal Points (17-19 June 2025) for further review and approval, with a view to be annexed to the draft decision for the updated EcAp Policy for the Mediterranean.

Conclusions et recommandations

A l'aimable invitation de Centre Hellénique de Recherche Marine (HCMR), la Réunion conjointe des Groupes de Correspondance sur l'Approche Écosystémique pour le Suivi de la Pollution et des Déchets Marins s'est tenue les 27 et 28 mai 2025 à Anavyssos, Grèce. La réunion a été organisée par le Secrétariat du PNUE/PAM et son Programme MED POL.

A l'issue de ses délibérations, la réunion a adopté les conclusions suivantes :

Point 3 de l'ordre du jour : Mise à jour de l'IMAP

a. Objectifs écologiques et indicateurs de pollution dans l'IMAP

b. . Objectif écologique et indicateurs relatifs aux déchets marins dans l'IMAP

1. La réunion a remercié le Secrétariat pour l'organisation de la réunion et pour la préparation des documents de travail.

2. À la suite de la présentation par le Secrétariat du document de travail UNEP/MED WG.626/3/Rev.1 intitulé « Mise à jour de l'IMAP pour les Objectifs écologiques 5, 9 et 11 », la réunion a examiné les Objectifs opérationnels actualisés, les Indicateurs communs de l'IMAP, les définitions du Bon État Écologique (BEE), ainsi que les Cibles pour les Objectifs écologiques 5 (eutrophisation), 9 (pollution) et 11 (bruit). Ces éléments avaient été proposés par le Secrétariat sur la base de l'Annex I du document de travail WG.602/3 précédemment validé par le Groupe de travail en ligne établi lors de la réunion du CorMon Pollution du 30 janvier 2025. La réunion a également pris en compte les modifications supplémentaires proposées au cours des discussions. Elle a approuvé la soumission des Objectifs écologiques 5, 9 et 11 actualisés, tels que présentés en appendice 1 aux conclusions et recommandations, à la réunion des Points focaux du MED POL (17–19 juin 2025). Cela inclut également l'accord visant à renforcer le suivi et l'évaluation du bruit impulsif et continu, sans pour autant élever les Indicateurs candidats 26 et 27 au statut d'Indicateurs communs.

3. À la suite de la présentation du document UNEP/MED WG.626/6, « Mise à jour de l'IMAP pour l'Objectif écologique 10 », la réunion a examiné les Objectifs opérationnels actualisés, les Indicateurs communs de l'IMAP, les définitions du BEE et les Cibles pour l'Objectif écologique 10 (déchets marins). Elle a approuvé la soumission de la version mise à jour, intégrant les modifications présentées dans l'Annexe 2 aux conclusions et recommandations, à la réunion des Points focaux du MED POL, qui se tiendra du 17 au19 juin 2025.

4. La réunion a examiné le document UNEP/MED WG.626/9 intitulé « Programme intégré révisé de surveillance et d'évaluation de la mer et des côtes méditerranéennes et critères d'évaluation connexes pour la pollution et les déchets marins (OE5, OE9, OE10, OE11) ». Elle a considéré les Indicateurs communs de l'IMAP actualisés pour les Objectifs écologiques 5, 9, 10 et 11, tels que proposés par le Secrétariat, en s'appuyant sur la version examinée lors de la 11e réunion du Groupe de coordination pour l'Approche écosystémique (2 octobre 2024), ainsi que sur les modifications supplémentaires proposées par les participants. La réunion a approuvé leur soumission, telle que décrite dans l'appendice 3 aux conclusions et recommandations, à la réunion des Points focaux du MED POL (17–19 juin 2025). Cette soumission comprend une annexe présentant les critères d'évaluation approuvés par la CdP23 (Décision IG.26/3), avec un ajout pour l'Indicateur commun 24 et la correction d'erreurs mineures dans l'Indicateur commun 14, sur la base de propositions de deux Parties contractantes.

5. En approuvant le document UNEP/MED WG.626/9, la réunion a souligné le caractère évolutif des critères d'évaluation et l'importance de leur mise à jour régulière, en particulier dans le cadre de la troisième édition du Rapport sur l'état de l'environnement en Méditerranée. La réunion a souligné la nécessité d'intégrer les considérations de toxicité dans les futures évaluations du BEE/de l'état environnemental. La réunion a convenu de créer des groupes de travail en ligne chargés d'examiner la littérature scientifique et de compiler des données relatives aux nutriments, aux tests de toxicité, à la

présence de contaminants et à l'analyse des biomarqueurs, afin d'améliorer les critères d'évaluation de l'eutrophisation, des contaminants dans le biote et les sédiments, et des biomarqueurs.

6. Concernant la composante « déchets marins » (OE10 de l'IMAP) du document UNEP/MED WG.626/9, la réunion a convenu d'introduire deux nouveaux Indicateurs communs, comme suit :

a) **Indicateur commun 24 :** Tendances de la quantité de déchets ingérés par les organismes marins et du nombre d'individus empêtrés dans des déchets marins (OE10).
b) **Indicateur commun 28 :** Tendances de la quantité de déchets provenant de sources fluviales (OE10)

Point 4 de l'ordre du jour : Fiches d'orientation pour les indicateurs de pollution de l'IMAP

7. La réunion a approuvé les « Fiches d'orientation mises à jour pour les Indicateurs communs 13, 14, 17, 18, 20 et 21 » (UNEP/MED WG.626/4/Rev.1) et les « Fiches d'orientation mises à jour pour les Indicateurs communs candidats 26 et 27 » (UNEP/MED WG.626/5/Rev.1), telles que révisées et présentées dans l'appendice 4 et 5 4 aux conclusions et recommandations, ainsi que leur soumission à la réunion des Points focaux du MED POL (17–19 juin 2025) pour approbation sans objection. Ces mises à jour reflètent les modifications convenues pendant la réunion et garantissent la cohérence avec l'IMAP révisé pour les Objectifs écologiques 5, 9 et 10 (UNEP/MED WG.626/3/Rev.1 et UNEP/MED WG.626/9).

Point 5 de l'ordre du jour : Valeurs de référence (VR) et Valeurs seuils (VS) pour l'Indicateur candidat 24 de l'IMAP

8. La réunion a examiné le document UNEP/MED WG.626/7, « Valeurs de référence (VR) et Valeurs seuils (VS) pour l'Indicateur candidat 24 de l'IMAP », et a salué la version mise à jour préparée par le Secrétariat (MED POL et SPA/RAC) sous la direction d'un Groupe de travail en ligne composé d'experts de France, de Grèce et d'Italie, qui a amélioré l'analyse et les valeurs proposées.

9. La réunion a demandé plusieurs modifications au document, en particulier dans la section relative à l'empêtrement, afin d'y intégrer les changements suivants [sous la supervision générale du Groupe de travail en line déjà établi] :

a) Vérifier de nouveau le nombre de données figurant dans le Tableau 1, améliorer la formulation relative à la Fréquence d'Occurrence (FO) et séparer le tableau en deux pour ingestion et empêtrement ;
b) Conserver l'approche utilisée pour l'ingestion afin d'exclure les individus dont le contenu stomacal est nul du calcul de la TV ;
c) Utiliser l'approche du 15e percentile pour l'intrication par ingestion appliquée au nombre total d'échantillons ;
d) Ajouter une référence explicite dans le document indiquant que les valeurs résultantes seront mises à jour lors de la prochaine édition du Rapport sur l'état de l'environnement en Méditerranée.

10. La réunion a recommandé la soumission de la version révisée du document UNEP/MED WG.626/7 à la réunion des Points focaux du MED POL (17–19 juin 2025) pour examen et approbation ultérieurs.

Point 6 de l’ordre du jour : Mandat et modalités d’interaction des Groupes de correspondance sur le suivi et des Groupes de travail en ligne

11. La réunion a examiné le document UNEP/MED WG.626/8, « Mandat et modalités d’interaction des Groupes de correspondance sur le suivi et des Groupes de travail en ligne », avec un accent particulier sur les sections concernant CORMON. Elle a approuvé sa soumission à la réunion des Points focaux du MED POL (17–19 juin 2025) pour examen et approbation ultérieurs, en vue d'être annexé au projet de décision pour la politique EcAp actualisée pour la Méditerranée.

Appendix 1

IMAP update for Ecological Objectives 5, 9 and 11

Table of Contents

1. Implementation of Integrated Monitoring and Assessment Programme Ecological Objectives 5 and 9

1. The Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (CorMon Pollution), held online on 30 January 2025, agreed to maintain the structure of the 5th Ecological Objective (EO 5) on Eutrophication and the 9th Ecological Objective (EO 9) on Contaminants, as originally established in Decision IG.20/4 "*Implementing MAP ecosystem approach roadmap: Mediterranean Ecological and Operational Objectives, Indicators and Timetable for implementing the ecosystem approach roadmap*", and Decision IG.22/7: "*Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria*" (COP 19, 2016), and aligned with the earlier framework set out in Decision IG.21/3: "*Ecosystem Approach including adopting definitions of Good Environmental Status (GES) and Targets*" (COP 18, 2013).

2. This conclusion involves retaining the following list of IMAP Common Indicators related to Ecological Objective 5 (EO 5).

Common Indicator 13:	Concentration of key nutrients in water column (EO5);
Common Indicator 14:	Chlorophyll-a concentration in water column (EO5).

3. This conclusion also involves retaining the following list of IMAP Common Indicators related to Ecological Objective 9 (EO 9).

Common Indicator 17:	Concentration of key harmful contaminants measured in the relevant matrix (EO9, related to biota, sediment, seawater);
Common Indicator 18:	Level of pollution effects of key contaminants where a cause-and-effect relationship has been established (EO9);
Common Indicator 19:	Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution (EO9);
Common Indicator 20:	Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9);
Common Indicator 21:	Percentage of intestinal enterococci concentration measurements within established standards (EO9).

4. This document also presents Operational Objectives, IMAP Common Indicators, and GES Definitions for Ecological Objectives 5 and 9, as established by Decisions IG.20/4, Decision IG.22/7 and Decision IG.21/3. This follows the conclusion of the CorMon Pollution Meeting held on 30 January 2025, which decided not to introduce any changes.

5. Although the CorMon Pollution Meeting held on 30 January 2025 concluded to retain the targets as originally approved by Decision IG.21/3 on the Ecosystem Approach, including definitions of Good Environmental Status (GES) and targets, the present document introduces minor revisions to several targets associated with IMAP Common Indicators 13, 14, 17, 20, and 21, as shown in Table 1 below.

6. These revisions are necessary to ensure consistency between the proposals presented to and approved by the CorMon Pollution Meeting and the ongoing IMAP Pollution revision process, including the revision of the IMAP Guidance Factsheet presented in meeting document UNEP/MED WG.626/4.

7. The current revisions also include the reinstatement of targets for turbidity, water transparency and dissolved oxygen concentrations, in order to align with the established GES definition for Common Indicator 14 on Chlorophyll-a, as agreed upon in the 2017 MED QSR: "Natural levels of algal biomass, water transparency, and oxygen concentrations in line with prevailing physiographic, geographic, and weather conditions." Although the Online Working Group had recommended the removal of these targets—originally defined in Decision IG.21/3, the present document reconsiders the original GES definitions which identified turbidity, water transparency and dissolved oxygen as supporting parameters in the assessment of GES based on chlorophyll-a concentrations.

8. The consistency is necessary to ensure full compatibility between the elements proposed for the IMAP revision and those intended for integration into the Decision on the updated Ecosystem Approach (EcAp) implementation for 2026–2035. This decision is aimed for submission to the 24th Meeting of the Contracting Parties (COP 24) to the Barcelona Convention, scheduled for December 2025.

9. The proposed revised targets are aligned with the GES/non-GES classification approved and applied in the preparation of the 2023 MED QSR

2. Implementation of Integrated Monitoring and Assessment Programme Ecological Objective 11

10. Further to decision of the Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring (30 January, 2025), to maintain the structure of the 5th Ecological Objective (EO 5) on Eutrophication and the 9th Ecological Objective (EO 9) on Contaminants, the present document also proposes to maintain the structure of the 11th Ecological Objective (EO 11) on Energy including underwater noise as originally established in Decision IG.20/4 "*Implementing MAP ecosystem approach roadmap: Mediterranean Ecological and Operational Objectives, Indicators and Timetable for implementing the ecosystem approach roadmap*", and Decision IG.22/7 : "*Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria*" (COP 19, 2016).

Candidate Common Indicator 26: Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animals;

Candidate Common Indicator 27: Levels of continuous low frequency sounds with the use of models as appropriate

11. In addition, Table 2 below presents the proposed definitions of Good Environmental Status (GES) and associated targets for IMAP Candidate Common Indicators 26 and 27. These definitions were initially outlined in the Guidance Factsheets acknowledged by the 2019 MED POL Focal Points and have since been revised as part of the ongoing IMAP revision process as detailed in meeting document UNEP/MED WG. 626/5.

12. The proposed revised targets are aligned with the GES/non-GES classification approved and applied in the preparation of the 2023 MED QSR.

13. This document also proposes that the current CorMon Pollution Meeting endorses the elevation of IMAP Candidate Common Indicators 26 and 27 to IMAP Common Indicators. This recommendation

is grounded in the significant progress achieved in underwater noise assessment, culminating in the noise assessment featured in the 2023 Mediterranean Quality Status Report (MED QSR). This advancement builds upon the foundational framework established in the Guidance Factsheet endorsed by the 2019 Meeting of MED POL Focal Points for further elaboration to incorporate evolving scientific knowledge, and the subsequent upgrade as presented in meeting document UNEP/MED WG.626/5.

Table 1: Operational Objectives, IMAP Common Indicators, GES Definitions and Revised Targets for Ecological Objectives 5 and 9.

Ecological Objective 5 (EO5): Human-induced eutrophication is prevented, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters			
Operational Objective	Indicator	GES	Revised Targets
5.1 Human introduction of nutrients in the marine environment is not conducive to eutrophication	5.1.1 Concentration of key nutrients in the water column (IMAP Common Indicator 13)	Concentrations of nutrients in the euphotic layer are in line with prevailing physiographic, geographic and climate conditions	State: • Reference nutrients concentrations according to the local hydrological, chemical, and morphological characteristics of the un- impacted marine region. • Decreasing trend of nutrients concentrations in water column of human impacted areas statistically defined, considering the boundary limit between GES and non-GES classes of the assessment scales. Pressure: • Reduction of BOD emissions from land-based sources. • Reduction of nutrients emissions from land-based sources.
5.2 Direct and indirect effects of nutrient over- enrichment are prevented	5.2.1 Chlorophyll-a concentration in the water column (IMAP Common Indicator 14)	Natural levels of algal biomass, water transparency and oxygen concentrations in line with prevailing physiographic, geographic, and weather conditions	State: • Chlorophyll a concentration in high-risk areas below the boundary limit between GES and non-GES classes of the assessment scales. • Decreasing trend in Chl-a concentrations in high-risk areas affected by human activities. • Index of turbidity below the boundary limit between GES and non-GES classes of the assessment scales to be set upon defining the turbidity assessment criteria [1]. • Increasing trend of transparency in areas impacted by human activities[2]. • Dissolved oxygen concentrations in high-risk areas below the boundary limit between GES and non-GES classes of the assessment scales to be set upon defining the oxygen concentrations assessment criteria [3]. • Increasing trend in dissolved oxygen concentrations in areas impacted by human activities[4].

[1] Transferred from Indicator 5.2.2, Decision IG. 21/3, Annex I
[2] ibidem

[3] Transferred from Indicator 5.3.1, Decision IG. 21/3, Annex I
[4] ibidem

Ecological Objective 9 (EO9): Contaminants cause no significant impact on coastal and marine ecosystems and human health			
Operational Objective	Indicator	GES	Revised Targets
9.1 Concentration of priority contaminants is kept within acceptable limits and does not increase	9.1.1 Concentration of key harmful contaminants measured in the relevant matrix (IMAP Common Indicator 17)	Level of pollution is below a determined threshold defined for the area and species.	State: • Concentrations of specific contaminants below either the boundary limit between GES and non-GES classes of the assessment scales or below reference concentrations (from other sources). • No [increasing] trends in contaminants concentrations in sediment and biota from human impacted areas, statistically defined. Pressure: • Reduction of contaminants emissions from land-based sources.
9.2 Effects of released contaminants are minimized	9.2.1 Level of pollution effects of key contaminants where a cause-and-effect relationship has been established (Common Indicator 18)	Concentrations of contaminants are not giving rise to [negative effects on health status of marine biota] []	State: • Contaminants effects below thresholds. [Pressure:] • Decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and offshore activities
9.3 Acute pollution events are prevented, and their impacts are minimized	9.3.1 Occurrence, origin (where possible), and extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances) and their impact on biota affected by this pollution (Common Indicator 19)	Occurrence of acute pollution events are reduced to the minimum.	Pressure: • Decreasing trend in the occurrences of acute pollution events.Achieve the elimination of intentional pollution of the marine environment by oil and other harmful and noxious substances (HNS) and the minimization of accidental discharge of such substances.
9.4 Levels of known harmful contaminants in major types of seafood do not exceed established standards.	9.4.1 Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (Common Indicator 20)	Concentrations of contaminants are within the regulatory limits for consumption by humans.	State: • Concentrations of contaminants in foodstuffs are below the UNEP/MAP Environmental Assessment Criteria approved for the protection of human health, . • Decreasing trend in the frequency of cases of seafood samples above the approved UNEP/MAP Environmental Assessment Criteria
9.5 Water quality in bathing waters and other recreational areas does not undermine human health	9.5.1 Percentage of intestinal enterococci concentration measurements within established standards (IMAP Common Indicator 21)	Concentrations of intestinal enterococci are within established standards	• Increasing trend in the percentage of intestinal enterococci concentration measurements that fall in the approved GES categories as established in Decision IG.20/9 and the EU 2006/7 Directive.

Table 2: Operational Objectives, IMAP Candidate Common Indicators 26 and 27, GES Definitions and Revised Targets for Ecological Objective 11.

Ecological Objective 11 (EO 11): Noise from human activities causes no significant impact on marine and coastal ecosystems			
Operational Objective	Indicator	GES	Targets
11.1 Energy inputs into the marine, environment, especially noise from, human activities, are minimized[5]	11.1.1. Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animal (Candidate Common Indicator 26)[6]	Noise from human activities causes no significant impact on marine and coastal ecosystems	State: The extent (%) of habitat of noise-sensitive species within the assessment area that is impacted by impulsive noise events is below thresholds.
11.2. Energy inputs into the marine, environment, especially noise from, human activities, are minimized	11.2.1. Levels of continuous low frequency sounds with the use of models as appropriate (Candidate Common Indicator 27)[7]	Noise from human activities causes no significant impact on marine and coastal ecosystems	State: • The extent (%) of the assessment area which is above levels causing disturbance to sensitive marine animal is below limits, or such limits are exceeded for a limited amount of time.

[5] Decision IG.20/4, Annex II
[6] Decision IG.20/4, Annex II; IG.22/7
[7] ibidem

Appendix 2

IMAP update for Ecological Objective 10 Updated Guidance Factsheets for

IMAP Common Indicators 13, 14, 17, 18, 20 and 21

Note by the Secretariat

The Integrated Monitoring Programme for the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP) was established in 2016 during COP19 (Decision IG.22/7), containing elements pertinent to its principles and structure, integrated monitoring and assessment, integrated data and information system, as well as monitoring and assessment requirements for 11 Ecological Objectives (EOs) and the corresponding 27 Common and/or Candidate Indicators (CIs). All these information was further detailed in the IMAP Guidance (UNEP(DEPI)/MED IG.22/Inf.7).

IMAP Ecological Objective 10 (EO10), having a focus on Marine Litter was developed on the basis of 2 Common and 1 Candidate Indicators. The implementation of IMAP EO10 has advanced significantly since 2016, resulting into national IMAP-based monitoring programmes, development of assessment criteria, and most importantly the preparation of dedicated chapters in the framework of the 2017 and 2023 Mediterranean Quality Status Reports (MED QSR).

Based on the experience gained from IMAP implementation at national, sub-regional and regional levels, and the assessment finding of the recent 2023 MED QSR; the Contracting Parties to the Barcelona Convention, through Decision IG.26/3 of COP23, called for revising Ecosystem Approach (EcAp) and IMAP, and in particular the enhancement of IMAP implementation and strengthening of national monitoring and assessment capacities, with the view to delivering and reporting quality assured data and undertake reliable related assessments.

In this regard, the Secretariat and its MED POL Programme undertook preliminary work and prepared a preliminary proposal for updating IMAP EO10 – Marine Litter, which was presented during the CORMON Marine Litter Meeting held online in January 2025.

This document has been prepared along the same basis, in particular further elaborates proposals for GES Definitions and Proposed Targets for the 2 new/updated Common Indicators with the aim to be included in the updated Ecosystem Approach (EcAp) Policy and is submitted to the present Joint CORMON Pollution-Marine Litter Meeting for review and endorsement, for further submission to the Meeting of the MED POL Focal Points (June 2025, tbc).

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1. Introduction

1. The Meeting of the Ecosystem Approach Correspondence Groups on Marine Litter Monitoring (Online, 29 January 2025) agreed on the following structure of the 10th Ecological Objective (EO10) of IMAP on Marine Litter:

Marine Litter (EO10):	'Marine and coastal litter do not adversely affect coastal and marine environment.'
Common Indicator 22:	Trends in the amount of litter washed ashore and/or deposited on coastlines (EO10).
Common Indicator 23:	Trends in the amount of litter in the water column including microplastics and on the seafloor (EO10).
Common Indicator 24:	**Trends in the amount of litter ingested by marine organisms and in the number of individuals entangled in marine litter** (EO10).
Common Indicator **28**:	Trends in the amount of litter coming from riverine sources (EO10).

2. Updates and Developments with regards to Monitoring and Assessment of IMAP Ecological Objective 10 (EO10) - Marine Litter

2. Contracting Parties established national IMAP-based monitoring programmes in relation to Common Indicators 22 and 23 (in particular on beach macro-litter, seafloor macro-litter, and floating microplastics), and have been encouraged to also consider in their monitoring programmes the candidate indicator related to ingestion and entanglement of marine litter from sea turtles and to undertake pilot monitoring activities on the latter. In this regard, a number of countries (e.g., Tunisia, Lebanon, Morocco etc.) have piloted the establishment of IMAP-based national monitoring programmes also for IMAP Candidate Indicator 24.

3. Furthermore, Data Standards (DS) and Data Dictionaries (DD) have been developed and agreed region-wide for Common Indicators 22 and 23 (i.e., beach macro-litter, seafloor macro-litter, and floating microplastics), including the establishment of Threshold Values (TV) and updated Baseline Values (BV).

4. A considerable number of citizens, communities (NGOs, civil society initiatives), and environmental protection associations and institutes across the Mediterranean are already taking part in activities to tackle marine litter. Contracting Parties are encouraged to further engage them in the implementation of IMAP and empower them to help improve the evidence base needed for marine litter monitoring.

5. Regarding beach litter, cost-efficient and easy to follow monitoring and sampling methodologies and techniques are well established, as described in the Integrated Monitoring and Assessment Guidance, with at least two surveys per year in spring and autumn recommended and ideally 4 surveys per year in spring, summer, autumn and winter.

6. An updated list of beach litter categories and related items has been approved at regional level and integrated into the respective DS-DD.

7. Further alignment with the EU/MSFD joint list can be considered once this list is finalized and its ongoing update is completed.

8. Regarding monitoring of marine litter at the sea (Common Indicator 23), due to the low occurrence of litter in midwater, the common indicator focuses mostly on floating and seafloor litter, including microplastics.

9. Regional guidelines detailing the monitoring of floating microplastics have been developed by UNEP/MAP MED POL and agreed at regional level.

10. Regarding seafloor macro-litter (Common Indicator 23), opportunistic monitoring is the most cost- efficient method for sea-floor monitoring being jointly implementation with national/regional fish-stock assessment survey programmes (e.g., the Mediterranean International Bottom Trawl Surveys (MEDITS), with the use of compatible professional trawling operations. There may be other opportunities to couple marine litter surveys with other regular surveys (e.g., monitoring in marine reserves passenger ships for visual monitoring, etc.) or programmes on biodiversity, with methodologies and technical requirements prescribed in the Integrated Monitoring and Assessment Guidance Document.

11. A number of important steps have been also carried also with regards to riverine marine litter and the proposed Common Indicator **28**:

a) The "Guidelines for Monitoring Riverine inputs of Marine Litter" were developed and approved in 2023 (UNEP/MED WG.550/14/Rev.17);
b) Pilot monitoring has been tested in Israel and Morocco during the implementation of the EU-funded Marine Litter MED II Project (2020-2024); and
c) The Meeting "Enhancing Interregional Cooperation for Monitoring and Assessing Riverine Input of Marine Litter" was organized jointly with OSPAR, HELCOM and Black Sea Commission in the framework of MARLICE 2024 (Valencia, Spain, 23 May 2024).

12. Regarding ingestion and entanglement of marine litter from biota, in particular from sea turtles (i.e., proposed Common Indicator 24), a number of actions have been undertaken by UNEP/MAP, which have been reviewed and endorsed by the CPs, and subsequently have substantially improved the level of knowledge and information for this candidate indicator, including the following: (a) development of a report with the most representative species to be used for this indicator, including a short-listing; (b) region-wide protocols for monitoring interactions between marine litter and marine turtles (ingestion and entangling) with a view to harmonizing methods of data collection for monitoring and assessment; (c) assessment of the available data to propose GES targets; (d) assessment reports from the testing of the harmonized protocols (Algeria, Tunisia, Lebanon); (e) operational strategy for monitoring IMAP Candidate Indicator 24; (f) guidelines for the design of a regional network for monitoring & assessment of IMAP Candidate Indicator 24 in the Mediterranean; (g) data standards and data dictionaries and related data flow implemented; (h) pilot IMAP-based national monitoring programmes (Tunisia, Lebanon, Morocco).

13. Further to the above-stated information, the Secretariat feel that there is sufficient ground to have this candidate common indicator, being transformed into a common indicator and a relevant request from the Contracting Parties should be initiated.

14. Furthermore, it is important to note that while micro-litter and in particular microplastics are considered from IMAP-EO10, further work is still necessary at regional level, recognizing that our understanding of the potential impacts of microplastic on organisms and the environment is still under development. Contracting Parties are thus encouraged also to undertake pilots, further research work in this area (e.g., microplastics **and mesoplastics** on beaches, microplastics on sediment, **pellets on beaches** etc.).

15. The Integrated Monitoring and Assessment Guidance Document, and the Guidance Factsheets include further details and specifications on methodologies, scales of assessment, as well as technical considerations, which can guide the Contracting Parties during the development of their IMAP-based national monitoring programmes for marine litter (IMAP – EO10).

3. IMAP EO10 Marine Litter: Operational Objectives, Indicators, GES Definitions and Targets

16. Table 2 consolidates the list of respective indicators, GES definitions and targets for IMAP EO10, as previously prepared for the Meeting of the Ecosystem Approach Correspondence Groups on Marine Litter Monitoring (Online, 29 January 2025; WG.601/3), including new elements for the Common Indicator **28** and Common Indicator 24, highlighted in **bold**.

Table 2: Operational Objectives, Indicators, GES Definitions and Targets for IMAP EO10.

Ecological Objective 10 (EO10):	Marine and coastal litter do not adversely affect coastal and marine environment		
Operational Objective	Indicator	GES	Proposed Targets
10.1 The impacts related to properties and quantities of marine litter in the marine and coastal environment are minimized	10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines (including analysis of its composition, spatial distribution and, where possible, source)	Number/amount of marine litter items on the coastline do not have negative impacts on human health, marine life and ecosystem services	• Decreasing trend in the number of/amount of marine litter (items) deposited on the coast
	10.1.2 Trends in amounts of litter in the water column, including micro- plastics, and on the seafloor	Number/amount of marine litter items in the water surface and the seafloor do not have negative impacts on human health, marine life, ecosystem services and do not create risk to navigation	• Decreasing trend in the number/amount of marine litter items in the water surface and the seafloor
	10.1.3 Trends in the amount of litter coming from riverine sources	**Number/amount of litter items on riverbanks and water surface in estuaries do not have negative impacts on human health, marine life, ecosystem services and do not create risk to navigation**	• **Decreasing trend in the number/amount of litter items deposited on riverbanks and in water surface in estuaries**
10.2 Impacts of litter on marine life are controlled to the maximum extent practicable	10.2.1 **Trends in the amount of litter ingested by marine organisms and in the number of individuals entangled in marine litter**	• **Amount (g) of marine litter ingested by marine organisms do not alter populations of sentinel organisms** • **Number of individuals entangled in marine litter do not alter populations of sentinel organisms**	• • **Decreasing trend in the stomach content of the sentinel species.** • **Decreasing frequency of occurrence of sea turtles entangled in marine litter.**

Appendix 3

Revised Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria for Pollution and Marine Litter (EO5, EO9, EO10, EO11)

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Monitoring and assessment of pollution and marine litter related common indicators

Eutrophication (EO5):

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.

2. Eutrophication related Common Indicators:

Common Indicator 13: Concentration of key nutrients in water column (EO5);

Common Indicator 14: Chlorophyll-a concentration in water column (EO5).

3. The monitoring of eutrophication under IMAP builds on the ~~**existing**~~ **monitoring system of** UNEP/MAP MED POL Monitoring programme**.** ~~and most of~~ **T**~~t~~he~~-~~Contracting Parties ~~already~~ have **IMAP-based** monitoring programmes in place for eutrophication all over the Mediterranean basin**.**~~, which~~ ~~**however**~~ ~~constitutes a greater~~~~**particular**~~ ~~concern for the Adriatic than for the rest of sub-region.~~

4. The Contracting Parties, building on their ~~**existing**~~ national monitoring programmes**, the lessons learned during the initial phase of implementing the Integrated Monitoring and Assessment Programme** and previous MED POL experience **with** ~~**on**~~ eutrophication, ~~will~~ **update** ~~-these~~ ~~**updated**~~ **their IMAP-based national monitoring** programmes. ~~during the initial phase of IMAP~~~~**since 2016**~~, ~~with~~ **T**~~t~~he overall aim **is to enhance harmony and coherence among the national monitoring programmes and** to establish coherent datasets at the entire regional sea level.

5. The methodologies, **monitoring protocols** and quality control and quality assurance measures are ~~**have been made**~~ available for **the** Contracting Parties ~~to consider during the update of~~ ~~**and have been considered in**~~ ~~their~~ ~~**IMAP-based**~~ ~~national monitoring programmes are described,~~ in **line with** the **Indicators'** ~~Integrated Monitoring and Assessment~~ Guidance **Factsheets**. ~~, noting the differences of needed techniques based on the level of the eutrophication problem in different sub-regions and countries~~ ~~**as well as the numerous technical guidelines prepared by MED POL**~~.

6. The geographical scale of monitoring for the assessment of GES for eutrophication ~~will~~ depend**s** on the hydrological and morphological conditions of an area, particularly the freshwater inputs from rivers, ~~**the**~~ salinity, ~~**the**~~ general circulation, upwelling, and stratification.

7. The spatial distribution of the monitoring stations should thus, prior to the establishment of the eutrophication status of the marine sub-region/area, be risk-based and proportionate to the anticipated extent of eutrophication in the sub-region under consideration, as well as its hydrographic characteristics aiming for the determination of spatially homogeneous areas. Consequently, each Contracting Party ~~would be required to determine~~**has determine**~~**s**~~**d** the **optimal spatial distribution** ~~**frequency per year and optimum locations for their**~~ **of** monitoring~~/**sampling**~~ stations.

~~It is recommended that the Contracting Parties rely on the classification scheme on chl-a concentration (µg/l) developed by MEDGIG as an assessment method that is easily applicable by all Mediterranean countries, based on the indicative thresholds and reference values adopted therein (see Table 2, Appendix 2). In this context, water typology is a very important factor for the further development of classification schemes in a certain area regarding the definition of sub-regional thresholds for chlorophyll-a.~~

8. **The Contracting Parties should use reference conditions and boundary values for chlorophyll-a (Chl-a) and nutrients, as outlined in Annex I, developed and region-wide approved for major coastal water types in the Mediterranean, including their application in the GES/non-GES /environmental classifications. To this aim, further work is required to expand and upgrade the reference conditions and boundary values for the four Mediterranean sub-regions, ensuring optimal GES assessment.**

8. **~~Assessment criteria have been developed and region-wide agreed for the Mediterranean with regards to Common Indicators 13 and 14 (Decision IG.26/3 and Annex II to the present document), based on 5 major water typologies. The Contracting Parties are encouraged to use those assessment criteria while developing national assessments~~**

9. ~~In addition, countries, where~~ **~~needed and~~** ~~appropriate, may continue using the~~**~~alternative/~~** ~~existing different eutrophication assessment methods such as~~**~~(e.g.,~~** ~~TRIX, Eutrophication scale, EI, HEAT, etc. at sub-regional or national levels~~**~~), to complement the those developed under UNEP/MAP,~~** ~~for assessing eutrophication trends.~~

10. **The Contracting Parties should use** ~~**T**~~the assessment **methodologies~~y~~ as** ~~is well~~ **described** in the **Indicators'** ~~Integrated Monitoring and Assessment~~ Guidance **Factsheets** for eutrophication.~~The final report of the Informal Online working group on eutrophication (UNEP((DEPI)/MED WG.420/Inf.11) contains assessment criteria regarding eutrophication which are presented in Appendix 2 of this document.~~

11. ~~During the initial phase of IMAP implementation, w~~ **W**ork **should** ~~will~~ be undertaken **to upgrade** ~~develop~~ GES ~~thresholds~~ **reference conditions and boundary values for Chl-a,** nutrients, transparency, and oxygen**,** using an adequate geographical scale, as well as to harmoniz~~e~~ existing assessment tools**.** ~~through workshops, dialogue, comparative exercises at regional/sub-regional/subdivision levels.~~

12. ~~In addition, taking into account sub-regional differences, work will be also undertaken to develop assessment fact sheets for eutrophication common indicator based on specifics described in the Integrated Monitoring and Assessment Guidance.~~

13. **~~Moreover, IMAP Guidance Factsheets have been developed in 2019 for Common Indicators 13 and 14 (UNEP/MED WG.467/5), and Contracting Parties are encouraged to use them while implementing the IMAP-based national monitoring programmes.~~**

14. **Work should continue to further develope the assessment scales based on the monitoring scales, aiming for optimal integration of monitoring and assessment areas among the Ecological Objectives of IMAP.**

15. **The Contracting Parties should ensure that adequate interlaboratory quality assurance and quality control (QA/QC) procedures are established for IMAP-competent laboratories concerning Common Indicators 13 and 14, and to this aim intercalibration testing should be conducted, and the IMAP Info System should integrate data quality control categories. These efforts should be supported through greater harmonization of diverse data management systems at the international level.**

16. **The Contracting Parties should exchange experiences and strengthen their capacities in monitoring and conducting GES assessments at the national level, while also contributing to sub-regional and regional ~~levels~~ efforts for Common Indicators 13 and 14, based on the approved monitoring standards, assessment tools, and criteria within the framework of IMAP implementation.**

Contaminants (EO9):

17. The monitoring **~~concentrations of a range~~** of chemical contaminants in water, sediments and biota

under IMAP builds on the monitoring system with ~~has~~ a long-standing history in the Mediterranean, under the auspices of the UNEP/MAP Barcelona Convention, its Land-Based Protocol, and UNEP/MAP MED POL monitoring programme**s**. **~~The IMAP builds on these existing legislative bases, programmes.~~**

Contaminants related Common Indicators:

Common Indicator 17:	Concentration of key harmful contaminants measured in the relevant matrix (EO9, related to biota, sediment, seawater);
Common Indicator 18:	Level of pollution effects of key contaminants where a cause-and-effect relationship has been established (EO9);
Common Indicator 19:	Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution (EO9);
Common Indicator 20:	Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9);
Common Indicator 21:	Percentage of intestinal enterococci concentration measurements within established standards (EO9).

18. All Mediterranean countries, building on their **~~existing~~** national monitoring programmes,~~-~~**the lessons learned during the initial phase of implementing the IMAP and previous MED POL experience with contaminants, update ~~have~~** ~~programmes~~ **~~already in place~~** ~~in relation to~~ **their IMAP-based national monitoring programmes for** contaminants. **~~monitoring~~**.~~, however the~~**~~, with varying~~** ~~scope and scale of this monitoring varies.~~**~~between the countries. The IMAP~~** ~~thus,~~ **The overall aim is to enhance** ~~build more~~ **~~builds~~ ~~developing~~** harmony ~~in~~ **and coherence ~~between~~ among** the **~~various~~** ~~existing~~ **national** monitoring programmes **and to establish coherent datasets at the entire regional sea level**. **~~based on the agreed common indicators~~**.

19. Biological effects monitoring **has been progressively integrated ~~and~~** ~~is generally less widely established in both~~**~~part of~~ in the IMAP-based** national ~~and international~~ **monitoring** programmes**.**~~, and the number of countries undertaking such studies (and the intensity of the coverage) is much smaller. Therefore,~~ **I**~~it~~ **~~will be~~ is** essential ~~during the initial phase of IMAP~~ to further expand and develop the use of biological effects methods, **including the integration of chemical and biological effects monitoring and assessment,** to cover properly the EO9.

20. In addition, **it is** important ~~development areas during the initial phase IMAP will include harmonization of~~ **~~steps have been undertaken~~ to further harmonize** monitoring of **contaminants ~~targets (determinants and~~ in different matrices in order to optimize ~~within~~** assessment**s at regional**, sub-regional~~s~~, and national levels, **as well as to enhance ~~development of suites of~~** assessment criteria and **apply** integrated chemical and biological assessment methods**.**~~, and review of the scope of the monitoring programmes to ensure that those contaminants which are considered to be important within each assessment area are included in monitoring programmes.~~

21. ~~Noting the above, the Contracting Parties will update their existing contaminants-related monitoring programmes by building on their existing sampling station networks, existing methodologies and statistical tools, existing data sets, and existing time series as the basis of monitoring against a "no deterioration" objective, aiming to cover the monitoring of all contaminants related common indicators.~~

22. While ~~most~~ monitoring stations ~~already exists~~ **are well defined in the IMAP-based national**

monitoring programmes, there is also a need for **the** Contracting Parties to **strengthen** ~~include in their monitoring programme~~ ~~**consider**~~ ~~areas beyond the coastal areas in a representative and efficient way, where risks warrant coverage, in line with the Integrated Monitoring and Assessment Guidance~~ ~~**and stations towards**~~ **monitoring in offshore areas**.

23. The methodologies, **monitoring protocols and,** quality control and quality assurance measures, ~~**and reference methods**~~ **are** available for **the** Contracting Parties ~~**to consider during the update of their national monitoring programmes, are described**~~ in **line with** the **Indicators'** ~~IMAP~~ Guidance **Factsheets.** ~~**as well as the numerous technical guidelines**.~~

24. Regarding acute pollution events, while **the** Contracting Parties already have ~~an~~ existing monitoring obligations under Article 9 of the Prevention and Emergency Protocol, the efforts of which need to be strengthened, it is also foreseen that further analysis of the links between acute pollution events and effect on biota ~~and the development of specific assessment criteria for this latter~~ should ~~occur~~ **be enhanced**.

25. **IMAP-based** ~~**M**~~**m**onitoring of contaminants in biota used for human consumption also builds on **previous** ~~**existing**~~ monitoring requirements and ~~only~~ **measures contaminants in foodstuffs** ~~in fish and other seafood~~ **for which the maximum regulatory limits** have been set **as outlined in Annex I.** ~~in national and international regulations for public health reasons.~~

26. ~~National monitoring Programmes in this regard should at least consider the following contaminants for which regulatory levels have been laid down: Heavy metals (lead, cadmium, and mercury), polycyclic aromatic hydrocarbons, and dioxins (including dioxin-like PCBs),~~~~**also considered in line**~~ ~~with the species selection considerations described in the Integrated Monitoring and Assessment Guidance.~~

27. Regarding **the** percentage of intestinal enterococci**,** ~~concentration measurements within established standards), the Revised Mediterranean guidelines for bathing waters of 2007 based on the WHO guidelines for "Safe Recreational Water Environments" and on the EC Directive for "Bathing Waters" serve as a basis for monitoring~~ **threshold values** ~~**assessment criteria**~~ **are developed and region-wide** ~~values~~ agreed for the Mediterranean ~~region in COP 17~~ **through** Decision IG.20/9 on **"**Criteria and Standards for bathing waters quality in the framework of the implementation of Article 7 of the LBS Protocol**"**~~,~~ (**COP 17, 2012)** ~~UNEP/MAP, 2012) will be built on~~~~**26/3 and Annex II**~~ to **ensure** ~~further define~~ GES **assessment of bathing water quality.** ~~for the indicator on pathogens in bathing waters during the initial phase of IMAP.~~~~**the present document)**~~**.**

28. ~~Regarding assessment, the Report UNEP(DEPI)MED WG.394/Inf.3 on the development of assessment criteria for hazardous substances and the final report of the Informal Online working group on contaminants (UNEP((DEPI)/MED WG.420/Inf.12) present key recommendations which will be followed to establish a forward procedure for monitoring the achievement of GES for contaminants during the initial phase of IMAP (Appendix 2 of this Annex).~~

29. ~~Until EACs are defined under this follow-up, a two-fold approach could be adopted to support monitoring for the assessment of GES:~~

~~a) a threshold value for GES(BAC), to be set using concentrations from relatively unpolluted areas on a sub-regional level and~~
~~b) a decreasing trend should be observed from baseline values representing the actual level of contaminants concentrations.~~

30. ~~Thus, GES can be defined for toxic metals (Hg, Cd, Pb), chlorinated organic compounds, and PAHs, for which monitoring data exist as a result of running monitoring programmes, already during the initial phase of IMAP, and UNEP/MAP will conclude its relevant common indicator-based assessment in light with the above.~~

31. ~~In addition, during the initial phase of IMAP, UNEP/MAP will also prepare an adapted manual establishing the BAC and, when possible, the formulation of EAC for selected biomarkers in Mediterranean species.~~

32. **~~Assessment criteria have been developed and region-wide agreed for the Mediterranean with regards to Common Indicators 17, 18 and 20 (Decision IG.26/3 and Annex II to the present document). The Contracting Parties are encouraged to use those assessment criteria while developing national assessments.~~**

33.The Contracting Parties should use the Background Criteria (BC), Background Assessment Criteria (BAC) and Environmental Assessment Criteria (EAC) values, as outlined in Annex I, developed and region-wide approved for IMAP Common Indicators 17, 18 and 20 in the Mediterranean, including their application in the GES/non-GES /environmental classifications. To this aim, further work is required to regularly upgrade BC and BAC values, and to develop or upgrade the EAC values for IMAP Common Indicators 17, 18, and 20 by using data relevant to the specific ecological characteristics of the four Mediterranean sub-regions, ensuring optimal GES assessment.

33. **The Contracting Parties should use the assessment methodologies as described in the Indicators' Guidance Factsheets for Ecological Objective 9.**

34. **Work should continue in developing the assessment scales based on the monitoring scales, aiming for optimal integration of monitoring and assessment areas among the Ecological Objectives of IMAP.**

35. **The Contracting Parties should ensure that adequate interlaboratory quality assurance and quality control (QA/QC) procedures are enhanced for IMAP-competent laboratories concerning Common Indicators 17, 18 and 20, and to this aim intercalibration testing should be conducted, and the IMAP Info System should integrate data quality control categories.**

36. **The Contracting Parties should exchange experiences and strengthen their capacities in monitoring and conducting GES assessments at the national level, while also contributing to sub-regional and regional ~~levels~~ efforts for Common Indicators 17, 18, 19, 20 and 21, based on the approved monitoring standards, assessment tools and criteria within the framework of IMAP implementation.**

Marine litter (EO10):

38. Marine litter monitoring ~~of IMAP is based~~ **builds on the monitoring requirements of the** Regional Plan on Marine Litter Management in the Mediterranean (Decision IG.~~ 20/10, the MLRP~~**25/9, COP 22),** on the UNEP Guidelines for Comprehensive Beach Litter Assessment and on the Guidance on Monitoring of Marine Litter in Seas surrounding Europe and on the following agreed common ~~and candidate~~ indicators:

Common Indicator 22:	Trends in the amount of litter washed ashore and/or deposited on coastlines (EO10);
Common Indicator 23:	Trends in the amount of litter in the water column including microplastics and on the seafloor (EO10);
~~Candidate~~ **Common** Indicator 24:	Trends in the amount of litter ingested by marine organisms and in the number of individuals entangled in marine litter (EO10).
Common Indicator 28 :	**Trends in the amount of litter coming from riverine sources (EO10)**

39. ~~In addition, as marine litter monitoring is a new area for the Mediterranean, IMAP greatly builds on the UNEP Guidelines for Comprehensive Beach Litter Assessment and on the Guidance on Monitoring of Marine Litter in European Seas.~~

40. **All** Contracting Parties ~~will establish~~ **have established since 2016** national **IMAP-based** monitoring programmes ~~during the initial phase of IMAP~~ in relation to ~~the two~~ **C**~~c~~ommon **I**~~i~~ndicators **22 and 23 (in particular on beach macro-litter, seafloor macro-litter, and floating microplastics). The Contracting Parties** ~~encouraged to also consider~~ **should include** in their monitoring programmes ~~the~~ **Common**~~Candidate~~ Indicator **24** related to ~~ingested~~ **ingestion and entanglement of marine** litter **from sea turtles** and to undertake pilot monitoring activities on the latter**.** ~~**In this regard, a number of countries (e.g., Tunisia, Lebanon, Morocco etc.) have piloted the establishment of IMAP-based national monitoring programmes also for IMAP Candidate Indicator 24**~~.

41. ~~Furthermore, is strongly recommended that Contracting Parties, which currently have plans to monitor only in a subset of environmental compartments, start with small pilot research or development projects in other compartments. This would provide baseline data to make an informed decision about future, full-scale monitoring programmes. Without information on trends and amounts in all the marine compartments, a risk-based approach to litter monitoring and measures is not possible.~~

42. **The methodologies, monitoring protocols and quality control and quality assurance measures are available for the Contracting Parties in line with the Indicators' Guidance Factsheets.**

43. **The Contracting Parties should use the agreed Baseline Values (BV) and Threshold Values (TV[5]) for Common Indicators 22, 23 and 24 of IMAP EO10 as presented in Annex I – Part II. GES/nonGES assessment classification scales builds on the Threshold Values.**

44. **The Contracting Parties should encourage** ~~A considerable number of~~ citizens, communities (NGOs, civil society initiatives), and environmental protection associations and institutes across the Mediterranean ~~are already taking~~ **to take** part in activities **related** to ~~tackle~~ marine litter **monitoring**~~.~~ ~~Contracting Parties are encouraged to enable~~**further engage** ~~them in the implementation of IMAP and empower them to help improve the evidence base needed for marine litter monitoring.~~

45. Regarding beach **macro-**litter **(Common Indicator 22)**, cost-efficient and easy to follow

[5] **Threshold Values are subject to update for the third iteration of the MED QSR.**

monitoring and sampling methodologies and techniques are well established, as described in the **Indicator** ~~Integrated Monitoring and Assessment~~ Guidance **Factsheets**, with at least two surveys per year in spring and autumn recommended and ideally 4 surveys per year in spring, summer, autumn and winter.

46. **The Contracting Parties should establish their national monitoring programs for IMAP EO10 based on a** ~~A reduced~~ master list of litter categories and items ~~is~~ **as presented in** the **respective** ~~Integrated Monitoring and Assessment~~ **Indicator**-Guidance **Factsheets.** ~~with the most frequent items found in Mediterranean beaches.~~ **Further work is needed to update within IMAP EO10** ~~**with regards to**~~ **for beach macro-litter, the minimum size of recorded marine litter items which need to be considered as of** ~~increase from 0.5cm to~~ **2.5cm.**

47. ~~The Contracting Parties can build on this~~ reduced list as ~~a reference approach which is compatible with other lists, in relation to marine litter monitoring, and it~~ can be ~~used also as a practical guide for the field work, enabling a coordinated harmonized monitoring (including when operated by NGOs, as appropriate)~~**.**

48. Regarding monitoring **of marine** litter at the sea (Common Indicator ~~17~~**23**), due to the low occurrence of litter in midwater, the common indicator focuses on surface **floating** and seafloor litter**, including microplastics.** Due to the observation methodology (observation from ships), the type of marine macro-litter objects can only be noted during very short visual observation. Therefore, in contrast to beach litter, only rough litter categories can be determined, even though monitoring size categories should also include relevant small items, in line with the Integrated Monitoring and Assessment Guidance.

49. **The Contracting Parties are encouraged to apply the approved regional Guidelines detailing** the **monitoring** of **floating microplastics.** ~~will develop a specific Monitoring of floating litter protocol, on a regional level.~~

50. ~~Regarding m~~**Monitoring of** seafloor macro-litter (Common Indicator ~~17~~**23**), **focuses on** opportunistic monitoring **which** is **a** ~~the most~~ cost- efficient method ~~for sea-floor monitoring, building on~~ **, being jointly implemented with national/regional fish-stock assessment survey programmes (e.g.,** the Mediterranean International Bottom Trawl Surveys (MEDITS~~) and~~**), including the use of** compatible professional trawling operations~~. to couple monitoring efforts may be the best approach to monitor litter on the sea-floor.~~ There may be other opportunities to couple marine litter surveys with other regular surveys (**e.g.,** monitoring in marine reserves, ~~offshore platforms,~~ **passenger ships for visual monitoring,** etc.) or programmes on biodiversity, with methodologies and technical requirements prescribed in the **Indicator** ~~Integrated Monitoring and Assessment~~ **Indicator** Guidance **Factsheets**.

51. **Riverine litter is considered as part of IMAP EO10. The Contracting Parties should/are encouraged to apply the approved region-wide Guidelines for Monitoring Riverine inputs of Marine Litter.**

52. ~~Regarding ingested litter (Candidate Indicator 18), due to the limited availability of protocols and the state of knowledge, the candidate indicator's focus during the initial phase of IMAP is on sea turtle Caretta caretta. UNEP/MAP thus will develop during the initial phase of IMAP a monitoring protocol for marine litter in sea turtles with focus on relevant parameters for application in the Mediterranean.~~

53. **It is important to note that while micro-litter and in particular microplastics are considered in IMAP-EO10, further work is still necessary at regional level, recognizing that the understanding of the potential impact on organisms and in the environment is still under development. Contracting Parties are encouraged** ~~**also**~~ **to undertake pilot**~~**s**~~ **monitoring, further research and work in this area (e.g., microplastics and mesoplastic on beaches, microplastics on sediment, pellets on beaches etc.).**

54. **The Contracting Parties should monitor the ingestion and entanglement of marine litter from**

biota, in particular from sea turtles (Common Indicator 24) considering that the most representative species are identified; in line with the approved and available region-wide monitoring protocols addressing ingestion and entanglement; They are encouraged to consider taking into account the Regional Operational Strategy and apply the approved Baseline Values (BV) and Threshold Values (TV) (Annex I – Part II).

55. ~~**Further to the above-stated information, the Secretariat finds that there is sufficient ground to elevate this**~~ ~~ingested litter is a candidate common indicator,~~ ~~**into a common indicator, and a relevant request from the**~~ ~~Contracting Parties are not obliged to include its monitoring in their national integrated monitoring programmes during the initial phase of IMAP, but they are encouraged however to undertake pilots, further research on this~~ ~~**consultation process indicator should has been initiated**~~.

56. The ~~Integrated Monitoring and Assessment Guidance includes~~ **In designing, upgrading their national monitoring programme, and undertaking the respective assessment for EO10, the Contracting parties are encouraged to use the Indicators' Guidance Factsheets that detail technical specifications on assessment** methodologies~~,~~ **and** scales ~~, and technical considerations,~~ ~~programme's~~ ~~marine~~ ~~component. The report of the Informal Online working group on Marine Litter (UNEP((DEPI)/MED WG.420/Inf.13) present recommendations related to baselines (Appendix 2).~~

Energy including Underwater Noise (EO11):

57. **EO 11 is introduced in** ~~this part of~~ **IMAP** ~~has been prepared, thanks to~~ **with** the support of experts **of** ~~from~~ the Joint ACCOBAMS/ASCOBANS/CMS Working Group on Noise.

58. The two **Candidate C**~~c~~ommon **I**ndicators related to energy including underwater noise are:

Candidate **Common** Indicator 26:	Proportion of days and geographical distribution where loud, low, and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animals;
Candidate **Common** Indicator 27:	Levels of continuous low frequency sounds with the use of models as appropriate.

59. ~~Compared to MSFD Descriptor 11 related indicators (MSFD),~~ **Candidate Common I**ndicators 26 and 27 are more closely related to the acoustic biology of key marine mammal species of the Mediterranean which are known to be sensitive to noise, i.e., the fin whale, the sperm whale and the Cuvier's beaked whale. The ~~proposed~~ monitoring strategy of these two candidate indicators, ~~as spelled out~~ **is set** in the ~~Integrated Monitoring and Assessment~~ **Indicators'** Guidance **Factsheets,** ~~represents a basis for further work during the initial stage of IMAP towards~~ **ensuring** an effective and widely agreed monitoring of underwater noise at a regional scale.

60. In line with the above, **the Contracting Parties should consider including these two Candidate Common I**ndicators in **their IMAP-based national** monitoring programmes ~~and undertake activities on implementing these two common indicators~~. ~~on a pilot basis during the initial phase.~~

61. **Work should continue** ~~during the initial phase of IMAP to further developed these Ccandidate Iindicators, towards Ccommon Iindicators,~~ **by developing monitoring and assessment methodologies along with Threshold Values and GES/non-GES boundary values applied for continuous and impulsive noise.**

62. For GES assessment related to EO11, **the Contracting Parties should use** ~~three thresholds need to be established: a spatial and a temporal threshold concerning~~ **the approved threshold levels and applied to the percentage of habitat occupied by noise-sensitive species affected by impulsive noise events** concerning **Candidate Common** Indicator 26**, following a risk-based approach,** and a **single** ~~noise~~ **T**~~t~~hreshold **Value developed and applied to the percentage of habitat of noise-sensitive species affected by continuous noise** concerning **Candidate -Common** Indicator 27.

63. ~~During the initial phase of IMAP, the ACCOBAMS Secretariat in coordination with the competent MAP components will carry out the following tasks with a view to further develop technical aspects of the candidate indicators in particular:~~

- ~~a) Reviewing what spatial and temporal thresholds have been selected by European Member States for implementing impulsive noise indicator of D11~~
- ~~b) Fulfilling action CA 2b1 of the 2014-2016 Work Plan ("Identifying Noise Hotspots for cetaceans in the ACCOBAMS area which is relevant to the Mediterranean Sea Area as provided for in the Barcelona Convention"), in order to provide the necessary baseline information on space-time distribution of impulsive noise sources across the Mediterranean~~
- ~~c) Reviewing ambient noise data available for the Mediterranean Sea as a follow up of the present work in order to identify the threshold for continuous noise indicator 11.1.2.~~

64. **. Work should continue to improve the quality and availability of underwater noise data, as well as monioring and assessment practices.**

Annex I

IMAP ~~Updated~~ Assessment Criteria for Nutrients, Contaminants **and ~~Biomarkers~~ Marine Litter**[8]

[8] **Annex II updated in its entity. The Assessment Criteria for Nutrients, Contaminants and Marine Litter have been approved by COP23 (Decision IG.23/3, Annex II)**

Annex I: IMAP Assessment Criteria for Nutrients, Contaminants and Marine Litter

PART I: Pollution (IMAP EO5 and EO9)

1. The assessment criteria for Common Indicators 13 and 14[9]

Table 1. Major coastal water types in the Mediterranean

	Type I	Type II-A, II-A Adriatic	Type III-W	Type III-E	Type Island-W
σt (density)	<25	25<d<27	>27	>27	All ranges
S (salinity)	<34.5	34.5<S<37.5	>37.5	>37.5	All ranges

Note: With the view to assess eutrophication, the classification scheme on Chl a concentration (in µg/l)is optimal in coastal waters as a parameter easily applicable by all Mediterranean countries based on the indicative thresholds and reference values presented in Table 3.
Note: The major coastal water types are also indicative of the part of offshore waters next to coastal waters; however, it should be used with caution in the offshore (open) areas.

Table 2. Coastal water types reference conditions and boundary values in the Mediterranean, along with the new and updated values for coastal and open (offshore) waters in the Adriatic Sea Sub-region[10].
(Reference conditions and boundary (Good/Moderate status) values, expressed as G_mean annual values, are based on long time series (>5 years) of monthly sampling at least, which differ from type to type on the sub-regional scale, and therefore, were built with different strategies).

	Coastal waters					
	Reference conditions of *c*(Chl*a*) (µg/L)		Boundaries of *c*(Chla) (µg/L) for G/M status		Reference conditions of *c*(TP) (µmol/L)	Boundaries of *c*(TP) (µmol/L) for G/M status
Water Typology	*G_mean*	90% percentile	*G_mean*	90% percentile		
Type I	1.19 .	3.33[b]	4.1 .	10		
Type I Adriatic	1.40	3.94	5.0[a]	14.1	0.19 [a]	0.55 [a]
Type II-A-FR-SP[d]	0.78[11]	1.9	1.48	3.50[12]	-	-
Type II-A Adriatic	0.33	0.87	1.5	4.0	0.16 [a]	0.48 [a]
Type II-A[e] Tyrrhenian	0.32	0.77	1.2	2.9	-	-
Type III-W Adriatic[c]	-	-	0.64[f]	1.7[f]	-	0.26
Type III-W Tyrrhenian	-	-	0.48	1.17	-	-

[9] For ease of reference, the Secretariat included the values as approved by Decisions IG.22/7 (COP 19) and IG. 23/6 (COP 20) which are shown in shaded cells.
[10] The new values are calculated based on data as available by December 2022.
[11] Gmean values corresponding to the reference and boundary values of Chla (expressed as the 90th percentile) are provided for Type II A FR SP and Type III W FR SP, along with the corrected calculation of Gmean value for Type I, compared to those included in Decisions IG.22/7 and IG.26/3, shown in blue shaded cells
[12] The value of 3.58 µg/L is corrected to 3.50 µg/L for Type II A FR SP in comparison to the values provided in Decision IG.22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (COP 19, 2016) and Decision IG.26/3 on 2023 MED QSR and a Renewed Ecosystem Approach Policy in the Mediterranean (COP 23, 2023), following the identification of an error by the Joint Meeting of CorMon on Pollution and Marine Litter Monitoring held on 27–28 May 2025 in relation to the boundary values used in the 2023 MED QSR.

Type III-W-FR-SP	0.37	0.9	0.74] [f]	1.89[13]	-	-
Type III-E		0.1		0.4		
Type Island-W		0.6		1.2-1.22		

Water Typology	Open (offshore) waters in the Adriatic Sea Sub-region					
	Reference conditions of *c*(Chl*a*) (µg/L)		**Boundaries of *c*(Chl*a*) (µg/L) for G/M status**		**Reference conditions of *c*(DIN) (µmol/L)**	**Boundaries of *c*(DIN) (µmol/L) for G/M status**
	G_mean	90 % percentile	*G_mean*	90 % percentile		
Type I Adriatic	0.15[g]; 0.29[h]	0.42[f]; 0.81[g]	3.1	8.7	0.21[g]; 0.66[h]	22.3
Type II-A Adriatic	0.11	0.29	-	-	-	-
Type III-W Adriatic [c]	-	-	0.64	1.7	-	-

[a] From Giovanardi et al, 2018
[b] Applicable to Golf of Lion Type I coastal waters
[c] The ecological classification scheme would not be suitable for proper and safe classification, and therefore the boundary values for WT III-W Adriatic waters are based on the H/G values for WT II-A Adriatic in coastal waters i.e. 0.64 µg/L for Chla and 0,26 µmol/L for TP
[d] Correction of error included to ensure consistency with the classification as provided in Commission Decision 2013/480/EU i.e. Type II -FR-SP, as included in Decision IG.22/7, replaced with Type II -A-FR-SP
[e] Correction of error included to ensure consistency with the classification as provided in Commission Decision 2013/480/EU i.e., Type II-A Tyrrhenian replaced Type II-B Tyrrhenian, as included in Decision IG.22/7, since the latter does not exist in the Tyrrhenian Sea
[f] values based on the H/G values for WT II-A[c] The ecological classification scheme would not be suitable for proper and safe classification, and therefore the boundary values for WT III-W Adriatic waters are based on the H/G values for WT II-A Adriatic in coastal waters i.e. 0.64 µg/L for Chla and 0,26 µmol/L for TP
[g] for ME; [h] for HR, IT
[h] No pressure – effect relationship was found, and therefore RC for DIN and boundary G/M values for Chla and DIN could not be proposed.

2. The assessment criteria for IMAP Common Indicator 17[14][15]

2.1 The BC and BAC values for IMAP Common Indicator 17

Table 3. The BC and BAC values for trace metals in sediments. The units of concentration are given in µg/kg dry wt, as requested by IMAP.

The BC and BAC values for trace metals in sediments					
The BC values in sediments, µg/kg dry wt					
TM	MED	WMS	ADR	CEN	AEL
Cd	107	140	120	#	78.9
Hg	50.0	90.0	50.0	#	31.5
Pb	15000	16000	15700	1805	15674
The BAC values in sediments, (µg/kg dry wt)					

[13] The value of 1.80 µg/L is corrected to 1.89 µg/L for type III W FR SP in comparison to the values provided in Decisions IG.22/7 and Decision IG.26/3, following the identification of an error by the Joint Meeting of CorMon on Pollution and Marine Litter Monitoring held on 27–28 May 2025 in relation to the boundary values used in the 2023 MED QSR.
[14] For ease of reference, the Secretariat included the values as approved by Decisions IG.22/7 0F (COP 19) and IG. 23/6 (COP 20) which are shown in shaded cells.
[15] The new values are calculated based on data as available by December 2022

	Med	WMS	ADR	CEN	AEL
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.*

Table 4. The BC and BAC values for Polycyclic Aromatic Hydrocarbons **(**PAHs) in sediments. The units of concentration are given in µg/kg dry wt, as requested by IMAP.

The BC and BAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments					
	The BC values in sediments, µg/kg dry wt				
PAH compounds	MED	WMS	ADR	CEN	AEL
Naphthalene	2.00	8.0	2.0	#	2.3
Acenaphthylene	(1.0)#	#	#	0.4	#
Acenaphthene	(2.0)#	#	#	*	#
Fluorene	(2.0)#	#	#	0.4	#
Phenanthrene	3.10	14.9	3.5	0.8	3.1
Anthracene	(2.2)#	#	#	#	#
Fluoranthene	5.00	#	7.0	0.1	2.7
Pyrene	6.20	24.8	8.0	0.4	3.0
Benzo[a]anthracene	3.38	19.7	4.1	*	1.8
Chrysene	2.70	35.9	4.6	1.6	1.6
Benzo(b)fluoranthene	5.00	8.7	15.0	*	2.6
Benzo(k)fluoranthene	4.00	#	3.0	*	#
Benzo[a]pyrene	(4.0)#	#	4.0	#	1.0
Benzo[g,h,i]perylene	(4.2)#	#	5.7	*	1.8
Dibenz[a,h]anthracene	(1.0)#	7.0	#	*	#
Indeno[1,2,3-c,d]pyrene	(4.0)#	#	4.4	*	2.1
Sum PAHs	27.4	160	41.0	6.3	21.4
	The BAC values in sediments, µg/kg dry wt				
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
Sum PAHs	41.0	240	61.5	9.5	32.0

*#most data (>50%) below detection limit, * no data reported*

Table 5. The BC and BAC values for trace metals in mussel (*M. galloprovincialis*) and fish (*M. barbatus*) . The units of concentration are given as requested by IMAP.

The BC and BAC values for trace metals in mussel soft tissue (*M. galloprovincialis*), µg /kg dry wt					
The BC values					
TM	**MED**	**WMS**	**ADR**	**CEN**	**AEL**
Cd	710	1030	629	*	942>
Hg	77.9	85.0	75.4	*	110>
Pb	1100	1260	1000	*	2300>
The BAC values					
TM	**MED**	**WMS**	**ADR**	**CEN**	**AEL**
Cd	1065	1545	944	*	1413>
Hg	117	128	113	*	165>
Pb	1650	1890	1500	*	3450>

** Only a few data points were available for the CEN. The calculated BCs were lower than in other sub-regions, however, the few data are not representative of the CEN.*
> Since new data were not available in the AEL to update BC/BAC values for M. galloprovincialis, it was approved to use the values calculated in 2019.

The BC and BAC values for trace metals in fish muscle *(Mullus barbatus*), µg/kg wet wt					
The BC values					
TM	**MED**	WMS	ADR	CEN	AEL
Cd	3.9	*	5.3	*	3.6
Hg	40.6	*	120	*	33.7
Pb	18.3	*	40.8	*	13.5
BAC values					
	MED	WMS	ADR	CEN	AEL
Cd	7.8	*	10.6	*	7.2
Hg	81.2	*	240	*	67.4
Pb	36.6	*	81.6	*	27.0

** Given the lack of data, it was not possible to propose values for BC in these sub-regions, therefore it was approved to use the regional MED BC values for the GES assessment*

Table 6. The BC and BAC values for Polycyclic Aromatic Hydrocarbons **(**PAHs) in mussel (*M. galloprovincialis)* . The unit of concentration is given in µg/kg dry wt, as requested by IMAP. No data were available for the CEN and the AEL Sub-regions.

The BC and BAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in mussel (*M. galloprovincialis),* µg/kg dry wt			
BC values			
	MED	WMS	ADR
Naphthalene	0.56	0.52	#
Acenaphthylene	(0.05)#	#	#
Acenaphthene	(0.50)#	#	#
Fluorene	2.50	7.87	#
Phenanthrene	5.35	19.9	2.25
Anthracene	1.12	0.94	#
Fluoranthene	4.83	10.0	#
Pyrene	2.50	5.54	#
Benzo[a]anthracene	0.60	0.69	#
Chrysene	2.54	2.98	#

The BC and BAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in mussel (*M. galloprovincialis),* µg/kg dry wt			
Benzo(b)fluoranthene	1.00	1.36	#
Benzo(k)fluoranthene	1.00	0.73	#
Benzo[a]pyrene	(1.00)#	0.94	#
Benzo[g,h,i]perylene	1.00	0.67	#
Dibenz[a,h]anthracene	(0.10)#	#	#
Indeno[1,2,3-c,d]pyrene	(0.63)#	0.29	#
Sum 16 PAHs [16]	5.80	5.60	6.60
The BAC values			
	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	#
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	#
Sum 16 PAHs	8.70	8.40	9.90

#*most data (>50%) below detection limit;*

Table 7. The BAC values for organochlorinated contaminants (PCBs and pesticides) in sediments and mussel (*M. galloprovincialis*). The unit of soncentrations is given in µg/kg dry wt, as requested by IMAP. 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.

The BAC values for organochlorinated contaminants (PCBs and pesticides) in sediments and mussel (*M. galloprovincialis*)					
SEDIMENTS, µg/kg dry wt	MED	WMS	ADR	CEN	AEL
PCBs					
PCB28	0.10	#	#	#	0.09
PCB52	0.07	0.10	0.09	#	0.04
PCB101	0.10	0.16	0.16	*	#
PCB118	0.10	0.46	0.18	#	0.01
PCB138	0.11	0.26	0.24	#	#
PCB153	0.14	0.40	0.28	#	0.02

[16] Data dictionary gives 2 additional categories: Sum 4 PAHs Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) and Sum 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.

PCB180	0.09	0.13	0.13	#	#
Sum 7 PCBs	0.40	1.60	0.21	#	0.19
Pesticides					
γ-HCH (Lindane)	(0.1)#	#	#	*	0.02
DDE(p,p’)	(0.1)#	0.23	#	#	*
Hexachlorobenzene	(0.1)#	#	#	#	*
Dieldrin	(0)#		#	#	#
BIOTA – MG, µg/kg dry wt	MED	WMS	ADR	CEN	AEL
PCBs					
PCB28	0.20	0.07	1.38	*	*
PCB52	0.38	0.3	0.5	*	*
PCB101	1.20	1.1	1.4	*	*
PCB118	1.23	1.5	1.4	*	*
PCB138	2.31	2.4	3.3	*	*
PCB153	3.45	4.6	4.6	*	*
PCB180	0.50	0.3	0.5	*	*
Sum 7 PCBs	18.4	28.6	17.3	*	*
Pesticides					
γ-HCH (Lindane)	(1.0)#	#	#	*	*
DDE(p,p’)	3.05	3.05	*	*	*
Hexachlorobenzene	(0.5)#	#	#	*	*
Dieldrin	(1.0)#	#	*	*	*

*# most data (>50%) below detection limit. * no data reported*

2.2 The Environmental Assessment Criteria (EAC) values for IMAP CI 17

Table 8. The Mediterranean EAC values for trace metals in sediments and biota, as endorsed by Decision IG.23/6

The Mediterranean EAC values for trace metals in sediments and biota			
TM	**MedEAC***	**#MedEAC**	**#MedEAC**
	Sediments, µg/kg dry wt	***M. galloprovincialis*, µg/kg dry wt**	***Mullus barbatus*, µg/kg wet wt**
	IG.23/6	IG.23/6	IG.23/6
Cd	1200	5000	50
Hg	150	2500&	1000
Pb	46700	7500	300

** Med EAC values equal to ERL (Effects Range Low, Long et al. 1995, idem OSPAR values). # Med EAC values equal to the maximum regulatory levels for contaminants in foodstuffs as provided in EC/EU 1881/2006 and 629/2008 Directives*
& Not included in EU directives, but adopted by OSPAR

Table 9. The Mediterranean EAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments and biota, as endorsed by Decisions IG.23/6 and IG.22/7, along with a few updated values to ensure consistency with ERL Long et al., and OSPAR EAC values

The Mediterranean EAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments and biota				
	Sediments, µg/kg dw		**Biota Mussels, µg/kg dw**	
PAH compounds	**EAC* IG.22/7 and IG.23/6 - OSPAR and ERLs**	**ERL Long et al, 1995#**	**EAC** IG.22/7 and IG.23/6 - OSPAR**	**OSPAR#**
Naphthalene		160		340
Acenaphthylene		44		
Acenaphthene		16		
Fluorene		19		
Phenanthrene	240		1700	
Anthracene	85		290	
Fluoranthene	600		110	
Pyrene	660		100	
Benzo[a]anthracene	261		80	
Chrysene	384			
Benzo(b)fluoranthene				
Benzo(k)fluoranthene			260	
Benzo[a]pyrene	430		600	
Benzo[g,h,i]perylene	85		110	

The Mediterranean EAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments and biota				
	Sediments, µg/kg dw		**Biota Mussels, µg/kg dw**	
PAH compounds	**EAC* IG.22/7 and IG.23/6 - OSPAR and ERLs**	**ERL Long et al, 1995#**	**EAC** IG.22/7 and IG.23/6 - OSPAR**	**OSPAR#**
Dibenz [a,h]anthracene		63.4		
Indeno[1,2,3-c,d]pyrene	240			
Sum 16 PAHs		4022		

** Med EAC values equal to ERL (Effects Range Low, Long et al. 1995, idem OSPAR values)*
*** Med EAC values equal to OSPAR values*
 # Med EAC values equal to ERL (Effects Range Low, Long et al., 1995) which were not included in Decisions IG.22/7 and IG.23/6.

Table 10. The Mediterranean EAC values for for organochlorinated contaminants (PCBs and pesticides) in sediments and biota, as endorsed by Decisions IG.23/6 and IG.22/7 along with the one updated value**.**

The Mediterranean EAC values for for organochlorinated contaminants (PCBs and pesticides) in sediments and biota					
	Sediments			**Mussel**	**Fish**
PCBs	**EAC# IG.22/7 (µg/kg dry wt) – updated**	**EAC* IG.22/7 (µg/kg dry wt)**	**EAC** IG.23/6 (µg/kg dry wt)**	**EAC** IG.22/7 and IG.23/6 (µg/kg dry wt)**	**EAC** IG.22/7 and IG.23/6 (µg/kg lipid)**
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
Sum 7 PCBs	67,9				
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) or used by OSPAR (2009)*
*** From OSPAR (2009)*
#The EAC value of 11.5 µg/kg dry wt in Decision IG 22/7 originated probably from Long et al, 1995 as explained in document UNEP/MED 427/Inf.3. However, Long et al.,1995 present the ERL value of 22.7 µg/kg dry wt for Total PCBs in sediments but do not specify which congeners were considered. Moreover, OSPAR has not adopted an EAC value for the sum of 7 PCBs in sediments. Therefore, further to experience related to the preparation of the assessments within the 2023 MED QSR, the EAC value of 67,9 is included to present the sum of 7 individual IMAP PCB congeners.

3. The Environmental Assessment Criteria (EAC) related to IMAP Common Indicator 20

Table 11. The Mediterranean EACs values for CI 20 related to trace metals based on the maximum regulatory levels for trace metals in foodstuffs for the protection of human health, as provided in EC/EU Directives1881/2006 and its amendments 488/2014 and 1005/2015. The concentrations are presented in mg/kg wet wt.

The EAC CI 20 for trace metals- EU 1881/2006 directive and its amendments 488/2014 and 1005/2015			
	TM, mg/kg wet wt		
matrix	**Cd**	**Hg**	**Pb**
fish muscle	0.05-0.25	0.5-1	0.3
cephalopods	1		1
crustaceans	0.5	0.5	0.5
bivalve mollusc	1		1.5

Table 12. The Mediterranean EAC values for IMAP CI 20 related to Benzo(a)pyrene and sum of four PAHs based on the maximum regulatory levels for these contaminants in foodstuffs for the protection of human health, as provided in EC/EU EC Regulations 835/2011 and 1259/2011 amending Regulation (EC) 1881/200.6. The concentrations are presented in µg/kg wet wt.

The EACs values for CI 20 related to Benzo(a)pyrene and sum of four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluorantheneand chrysene) - EC Regulation (EC) 1881/2006 and amendments 835/2011 and 1259/2011		
Matrix	**Maximum levels (µg kg^{-1} wet wt)**	
	Benzo(a) pyrene	**Sum of Benzo(a) pyrene, Benzo(a) anthracene, Benzo(a) fluoranthene and chrysene**
Smoked fish muscle	2-5	12-30
Smoked bivalve mollusc	6	35
Bivalve mollusk (fresh, chilled or frozen)	5	30

Table 13. The Mediterranean EAC values for CI 20 related to Dioxins and PCBs based on the maximum regulatory levels for these contaminants in foodstuffs for the protection of human health, as provided in EC/EU EC Regulation 1259/2011 amending EC Regulation 1881/2006. The concentrations are presented in wet wt.

TheEACs values for CI 20 related to Dioxins and PCBs – EC Regulation 1259/2011 amending EC Regulation 1881/2006			
Foodstuffs	**Maximum levels**		
	Sum of dioxins (WHO-PCDD/F-TEQ) (1) pg g^{-1} ww	**Sum of dioxins and dioxin-like PCBS (WHO-PCDD/F-PCB-TEQ) (1) pg g^{-1} ww**	**Sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 (ICES 6) ng g^{-1} ww**
Fish muscle	3.5	6.5	75
Fish liver	3.5	20	200
Eel muscle	3.5	10	300

(1) Dioxins (sum of polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), expressed as World Health Organisation (WHO) toxic equivalent using the 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.).
Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish.

4. The Environmental Assessment Criteria (EAC) values for IMAP CI 18[17]

Table 14. The Mediterranean BACs and EACs for biomarkers in mussel (*M. galloprovincialis*) as endorsed by Decisions IG.22/7 and IG.23/6.

The Mediterranean BACs and EACs for biomarkers in mussel (*M. galloprovincialis*)				
Biomarkers/Bioassays and units	BACs IG.23/6 in Mussels (*Mytilus galloprovincilais)*	EACs IG.23/6 in Mussels (*Mytilus galloprovincilais)*	BACs IG.22/7 in Mussels (*Mytilus galloprovincilais)*	EACs IG.22/7 in Mussels (*Mytilus galloprovincilais*)
Lysosomal membrane stability Neutral Red Retention Assay (minutes)			120[a*]	50 [a*]
Lysosomal membrane stability Cytochemical method (minutes)			20 [a*]	10 [a*]
AChE activity (nmol min-1 mg-1 protein) in gills (French Mediterranean waters)			29	20
AChE activity (nmol min^{-1} mg^{-1} protein) in gills (Spanish Mediterranean waters)			15	10
Stress on Stress (days)	11	5		
Metallothioneins (µg/g digestive gland)	247			
Micronuclei frequency (number of cases /1000 cells) in haemocytes)	1			

[a]*Technical annex: assessment criteria for biological effects measurements. Integrated monitoring of chemicals and their effects. ICES Cooperative Research Report No. 315. Davies, I.M. and Vethaak, A.D.Eds.*
**Moore et al., 2006 (Standard values adopted by ICES)*

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[17] For ease of reference, the Secretariat included the values as approved by Decisions IG.22/7 0F (COP 19) and IG.23/6 (COP 20) which are shown in shaded cells.

PART II: Marine Litter (IMAP – EO10)[18]

5. Updated Baseline Values (BV) and Threshold Values (TV) for IMAP Common Indicator 22

Table 15: Updated Baseline Values and Threshold Values for IMAP Common Indicator 22 (i.e., beach mac~~rolitter).~~

IMAP Indicator	Categories of Marine Litter	Baseline Values (BV – 2021)	Threshold Value (TV – 2021)
Common Indicator 22	Beach Macro-litter	369 items/100m	130 items/100m

6. ~~Updated~~ Baseline Values (BV) and Threshold Values (TV) for IMAP Common Indicator 23

Table 16. ~~Updated~~ Baseline Values and Threshold Values for IMAP Common Indicator 23 (i.e., seafloor macrolitter, floating microplastic).

IMAP Indicator	Categories of Marine Litter	Baseline Values (BV – 2023)	Threshold Value (TV – 2023)
Common Indicator 23	Seafloor Macro-litter	135 items/km^2	38 items/km^2
Common Indicator 23	Floating Microplastics	0.044338 items/m^2	0.000845 items/m^2

7. ~~Updated~~ Baseline Values (BV) and Threshold Values (TV) for IMAP Common Indicator 24[19]

Table 17. ~~Updated~~ Baseline Values and Threshold Values for IMAP Common Indicator 24 (ingestion and entanglement)

IMAP Indicator	**Updated BV (2025)**	**Proposed TV (2025)**
~~Candidate~~ Common Indicator24: Ingestion	**0.4g ML ingested**	**0.03g ML ingested**
~~Candidate~~ Common Indicator 24: Entanglement	**36% affected sample**	**14% affected sample**

[18] Threshold Values are subject to update for the third iteration of the MED QSR.
[19] **The only new addition to this Annex I, subject to approval of the Joint Meeting of the Ecosystem Approach Correspondence Groups on Pollution and Marine Litter Monitoring (Anavyssos, Greece, 27 -28 May 2025).**

Appendix 4

Updated Guidance Factsheets for IMAP Common Indicators 13, 14, 17, 18, 20 and 21

Table of Contents

1. Introduction

1. This document presents the revised Guidance Factsheets for IMAP Common Indicators 13, 14, 17,
18, 20, and 21, revising the IMAP Pollution Cluster in accordance with Decision IG.26/3 (COP 23, 2023) concerning the 2023 Mediterranean Quality Status Report (MED QSR) and the Renewed Ecosystem Approach Policy in the Mediterranean.

2. The current revision builds upon achievements endorsed for the preparation of the 2023 Mediterranean Quality Status report (2023 MED QSR) by the Ecosystem Approach Correspondence Group on Pollution, MED POL Focal Points, and Ecosystem Approach Coordination Groups during meetings held in 2020, 2021, 2022 and 2023.

3. These foundational achievements determining the revision of the IMAP Pollution Cluster include:

a) **Strengthening the assessment criteria**, including:

i. Updating the Background Criteria (BC) and Background Assessment Criteria (BAC) values for IMAP Common Indicator 17, at both at sub-regional and regional levels, and the Environmental Assessment Criteria (EAC) values for IMAP Common Indicator 20.

ii. Setting reference conditions and Good/Moderate (G/M) boundary values for chlorophyll-a (Chl a), total phosphorus (TP), and dissolved inorganic nitrogen (DIN) in coastal and open (offshore) waters of the Adriatic Sea Sub-region.

iii. Proposing methodologies for the future revision of EAC values for IMAP Common Indicators 17, 18, and 20, set to commence implementation in 2025.

b) **Defining integration and aggregation rules for monitoring and assessment**, including:

i. Developing a methodology to propose assessment spatial scales based on monitoring scales defined in national IMAP Pollution monitoring programmes, while also taking into account the assessment areas established under national MSFD monitoring strategies by EU Member State Contracting Parties.

ii. Establishing rules for the integration of monitoring and assessment areas within the IMAP Pollution and Marine Litter Cluster (Ecological Objectives EO5, EO9, EO10), while considering interrelations with the Coast and Hydrography (EO6, EO7) and Biodiversity (EO1) Clusters.

iii. Setting rules for the aggregation and integration of assessments across specific IMAP Common Indicators and Ecological Objectives, contributing to an integrated Good Environmental Status (GES) assessment for the IMAP Pollution Cluster.

c) **Development, testing, and implementation of GES and alternative environmental assessment methodologies by applying the integration and aggregation rules, alongside the assessment scales, assessment criteria, and the DPSIR approach within the IMAP nested framework**. This work included:

i. the NEAT IMAP GES assessment methodology across the nested assessment areas (CIs 13, 14, and 17);

ii. the CHASE+ assessment methodology (CIs 13, 14, and 17);

iii. the Ecological Quality Ratio (EQR) methodology (CIs 13 and 14);

iv. the simplified EQR methodology (CI 14);

v. the simplified Good/Moderate (G/M) status comparison methodology (CI 14);

vi. the assessment approach for biological effects, based on the use of relevant literature sources;

vii. the assessment approach for contaminants in seafood, using concentration limits for contaminants regulated within the EU;

viii. the assessment approach for bathing water quality, incorporating both the results presented in the European Environment Agency's 2020 Assessment Report on the State of Bathing Water Quality and monitoring data reported under IMAP; and

ix. the adapted exposure index and assessment methodology in line with EU Threshold Values for Impulsive and Continuous Underwater Sound.

4. Despite the limited data reporting by the Contracting Parties, as stipulated in Decisions IG.23/6 and IG.24/4, based on the results outlined above, **seventeen thematic pollution assessments were developed in 2022 and 2023 for the nine Mediterranean Sea areas/sub-divisions**. These assessments provided the foundation for assessing the four Mediterranean sub-regions, as detailed in the 2023 Mediterranean Quality Status Report (2023 MED QSR). They currently serve as a basis for revising the assessment component of the IMAP Guidance Factsheet.

5. The current revision of IMAP Pollution i.e. Common Indicators 13&14, 17, 18, 20 and 21 also builds upon the following achievements:

d) **Monitoring Guidelines**: These are structured around specific 97 technical protocols for IMAP Common Indicators 13, 14, 17, 18, 20, and 21, and were comprehensively developed by the MED POL Programme in cooperation with IAEA/MESL. The guidelines were approved by the MED POL Focal Points Meeting in 2021, and thereafter used to reinforce national monitoring efforts.

e) **Preparation of National IMAPs** and lessons learned during their initial implementation phase.

f) **Data Standards and Data Dictionaries**: Developed and integrated into the IMAP Info System for IMAP Common Indicators 13, 14, 17, 18, 20, and 21 to support standardized and harmonized data reporting by the Contracting Parties.

g) **Advancement of Quality Assurance and Quality Control (QA/QC)** efforts through:

i. Upgrading interlaboratory QA/QC procedures for IMAP Common Indicator 17, and establishing QA/QC procedures for Common Indicators 13 and 14 (covering inorganic nutrients in high salinity seawater, estuarine and low salinity seawater, and chlorophyll a and phaeopigments in seawater), as well as contaminants in seafood for Common Indicator 20 (including heavy metals, PAHs, dioxins, and PCBs).

ii. Defining interlaboratory QA/QC procedures for IMAP Common Indicator 18.

iii. Establishing initial data quality control range categories for physico-chemical parameters (Common Indicators 13&14) and contaminants (Common Indicator 17), using appropriate statistical methods and scientific expertise to ensure the quality of data reported into the IMAP Info System. These quality control categories have been integrated into the system as of 2024.

h) **Incorporating New Scientific and Policy Developments**: Evolutions since 2019 have been leveraged to support the above achievements under IMAP Pollution monitoring and implementation.

2. Guidance Factsheet on IMAP Common Indicators 13 and 14

6. The revision of IMAP **Common Indicator 13 (EO5)**: "Concentration of key nutrients in water column" is presented in the table bellow.

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**[1]

[1] Following the decisions to be made at the present meeting regarding minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3/Rev.1, the revised Targets will be incorporated into the revised IMAP Pollution Indicators Factsheets.

<table>
<tr><td>Indicator Title</td><td colspan="2">Common Indicator 13. Concentration of key nutrients in water column (EO5)</td></tr>
<tr><td>Concentrations of nutrients in the euphotic layer are in line with prevailing physiographic, geographic and climate conditions</td><td>Human introduction of nutrients in the marine environment is not conducive to eutrophication</td><td>State:
• Reference nutrients concentrations according to the local hydrological, chemical, and morphological characteristics of the un-impacted marine region.
• Decreasing trend of nutrients concentrations in water column of human impacted areas statistically defined, considering the boundary limit between GES and non-GES classes of the assessment scales.
Pressure:
• Reduction of BOD emissions from land-based sources.
• Reduction of nutrients emissions from land-based sources.</td></tr>
<tr><td colspan="3">Rational</td></tr>
<tr><td colspan="3">Justification for indicator selection

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)[2]. The direct and indirect consequences of eutrophication are undesirable when they degrade ecosystem health and/or the sustainable provision of goods and services, such as algal blooms, dissolved oxygen deficiency, declines in sea-grasses, mortality of benthic organisms and/or fish. Although, these changes may also occur due to natural processes, the management concern begins when they are attributed to anthropogenic sources.
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.</td></tr>
<tr><td colspan="3">Scientific References
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</table>

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

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

doi:10.1016/B978-0444-9990-3.50022-5.

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Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

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Policy Context and targets

Policy context description

In the Mediterranean, the UNEP/MAP MED POL Monitoring programme included from its inception the study of eutrophication as part of its seven pilot projects approved by the Contracting Parties at the Barcelona meeting in 1975 (UNEP MAP, 1990a,b). The issue of a consistent monitoring strategy and assessment of eutrophication was first raised at the UNEP/MAP MED POL National Coordinators Meeting in 2001 (Venice, Italy) which recommended to the Secretariat to elaborate a draft programme for monitoring of eutrophication in the Mediterranean coastal waters (UNEP/MAP MED POL, 2003). In spite of a series of assessments reviewing the concept and state of eutrophication, there are important gaps in the capacity to assess the intensity of this phenomenon. Efforts have been devoted to defining the concepts to assess the intensity and to extend experience beyond the initial sites in the Adriatic Sea, admittedly, the most eutrophic area in the entire Mediterranean Sea. In the context of the Mediterranean Sea, the monitoring and assessment of eutrophication were redefined in accordance with the Integrated Monitoring and Assessment Programme (UNEP/MAP, 2016). This redefinition ensures synergy with the European Marine Strategy Framework Directive (200/56/EC). The Data Dictionaries and Standards for IMAP Common Indicators 13 and 14 (2019, http://imapinfosystem.info-rac.org/app/#/standard), aligned with the IMAP Guidance Factsheets, defined the list of mandatory datasets, including physico-chemical parameters, to provide an integrated assessment of eutrophication.

Targets

As part of the preparation for the 2023 MED QSR eutrophication assessment, the NEAT (Nested Environmental Status Assessment Tool) Integrated Assessment for CIs 13 and 14, and The Scale of Simplified Assessment of Chlorophyll a (IMAP Common Indicator 14) have been established and applied in the Mediterranean sub-regions to assess the Good Environmental Status (GES), as applicable. The scales are outlined in the Guidance Factsheet for Common Indicator 14.

The reference and boundary values for Dissolved Inorganic Nitrogen (DIN) and Total Phosphorus (TP) have only been set for the Adriatic Sea Sub-region. In the absence of such values for other sub-regions, the scales of other assessment methodologies could not be set, including the Scale of Simplified Assessment, which was only applied to Chlorophyll-a based on satellite-derived data.

Policy documents

General Policy documents

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets.

Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027.

Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.

Decision IG.24/4 (COP21, 2019) on Assessment Studies.

Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.

UNEP(DEPI)/MED WG.363/Inf.21. (2011) Initial Integrated Assessment.
UNEP(DEC)/MED WG.372/3. (2012) Approaches for definition of GES and setting targets for the pollution related ecological objectives in the framework of the ecosystem approach. (EO5: eutrophication, EP9: contaminants, EP10: marine litter, EO11: noise).

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

2017 Mediterranean Quality Status Report, https://www.medqsr.org/node/10/

2023 Mediterranean Quality Status Report, medqsr2023.info-rac.org
Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

Commission Directive (EU) 2017/845 of 17 May 2017 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies.

Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardized methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

Eutrophication related Policy documents

UNEP(DEPI)MED WG.231/14. (2003). Eutrophication Monitoring Strategy of UNEP/MAP MED POL.

UNEP/FAO/WHO (1996). 'Assessment of the state of eutrophication in the Mediterranean Sea'. MAP Technical Reports Series No 106. UNEP, Athens, 211 pp.

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

UNEP/MAP MED POL (1990a). Activity IV: Research on the effects of pollutants on Marine Organisms and their Populations (UNEP/MAP MED POL Phase I, 1975-1981).

UNEP/MAP MED POL (1990b). Activity V: Research on the effects of pollutants on Marine Communities and Ecosystems (UNEP/MAP MED POL Phase I, 1975-1981).

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

UNEP(DEPI)/MED WG.417/Inf.15., (2015) Report of the online groups on eutrophication, contaminants and marine litter, pp 92

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

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

UNEP/MED WG.463/Inf.9 (2019). Example of overall interrelationships between the IMAP and the DPSIR framework applied to the coastal and marine ecosystem. Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring.

UNEP/MED WG.509/10//Rev.2, (2021) Integration and Aggregation Rules for Monitoring and Assessment of (IMAP Pollution and Marine Litter Cluster).

UNEP/MED WG 533/ 4. (2022) Assessment Criteria Methodologies for IMAP Common Indicator 13: Reference and Boundary Values for DIN and TP in the Adriatic Sea Sub-region.

UNEP/MED.WG.550/10/Rev.1, (2023), 2023 Med QSR: The IMAP Pollution Cluster Chapters; Thematic Assessments.

UNEP/MED.WG.550/Inf.13 (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Assessment Results of IMAP Common Indicators 14 in the Central Mediterranean Sea Sub-region by Applying the Simplified G/M Assessment Methodology.

UNEP/MED WG.556/Inf.3/Rev.1. (2023), The Results of GES Assessment for IMAP Common Indicators 13 and 14 in the Adriatic Sea Sub-region by Applying the NEAT GES Assessment Methodology.

UNEP/MED WG.556/Inf.4/Rev.1. (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Assessment Results of IMAP Common Indicators 13&14 in the Aegean - Levantine Sea Sub-region by Applying the Simplified G/M Assessment Methodology.

UNEP/MED WG.556/Inf.5/Rev.1. (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Assessment Results of IMAP Common Indicators 13&14 in the Western Mediterranean Sea Sub-region by Applying the Simplified G/M and EQSR Assessment Methodologies .

UNEP/MED WG.556/Inf.16/Rev.1. (2023), 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 Adritic Sea Sub-region.

Indicator analysis methods

<table>
<tr><td>Indicator Title</td><td>Common Indicator 13. Concentration of key nutrients in water column (EO5)</td></tr>
<tr><td colspan="2">Indicator Definition

Concentration of key (inorganic) nutrients in the water column:
Nítrate (NO_3-N)
Nitrite (NO_2-N)
Ammonium (NH_4-N)
Total Nitrogen (TN)
Orthophosphate (PO_4-P)
Total Phosphorus (TP)
Orthosilicate (SiO_4-Si)

Sub-Indicators: Nutrient ratios (molar) of silica, nitrogen and phosphorus where appropriate:
Si:N, N:P, Si:P

The list of all chemical and related parameters subject to reporting for IMAP CI 13 by the Contracting Parties is elaborated in the Data Standards for IMAP CI 13.</td></tr>
<tr><td colspan="2">Methodology for indicator calculation

All: Spectrophotometry (manually or automated methods and instrumentation)

The detailed analytical procedure nutrients and other related mandatory parameters, including sampling and sample transportation, analytical determination of indicators and sub-indicators, data quality control are outlined in A-2: Guidelines/Protocols for sampling and determination of key nutrients and chlorophyll a in seawater outlines the analytical procedures for the determination of Chlorophyll a and its related sub-indicators.</td></tr>
<tr><td colspan="2">Indicator units

All: micromol per liter, that is micromolar concentration (µmol/L =µM)
Ratios: adimensional (simple mathematical derivation of ratios from nutrient concentrations)

Data Standards for IMAP CI 13 elaborates units for all mandatory parameters.</td></tr>
<tr><td colspan="2">List of Guidance documents and protocols available

i.
IMAP Monitoring Guidelines/Protocols (https://www.iaea.org/about/organizational-structure/department-of-nuclear-sciences-and-applications/division-of-iaea-environment-laboratories/marine-environmental-studies-laboratory/unep-map-med-pol-integrated-monitoring-and-assessment-programme-imap-monitoring-guidelines)
o A-1. Monitoring Guidelines/Protocols for Sampling and Determination of Hydrographic Physical and Chemical Parameters;
o A-2: Guidelines/Protocols for sampling and determination of key nutrients and chlorophyll a in seawater outlines the analytical procedures for the determination of Chlorophyll a and its related sub-indicators;
o E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
o F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.</td></tr>
<tr><td colspan="2">Data Confidence and uncertainties</td></tr>
</table>

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

Despite the great variability born by the water layers subject to active hydrodynamic processes, monitoring the characteristics of the seawater is still the most direct way of assessing eutrophication. Inorganic nutrients may be determined either at the surface or at various depths.

An external quality assurance by performing regional interlaboratory QA/QC exercises has been organized for contaminants in collaboration of the UNEP/MAP - MED POL and the IAEA/MESL since 1986. As of 2024, the IAEA/MESL, the scope of proficiency testing and training courses has been expanded to support the capacities of national laboratories in monitoring eutrophication (IMAP Common Indicators 13 & 14: inorganic nutrients in high salinity seawater, in estuarine and low salinity seawater, and chlorophyll a and Phaeopigments in Seawater) and contaminants in seafood (IMAP Common Indicator 20: heavy metals, polycyclic aromatic hydrocarbons (PAHs), dioxins, and PCBs).

In addition, the data quality control range categories were initially established for physico-chemical parameters related to the monitoring of IMAP Common Indicators 13 and 14, as well as for contaminants related to the monitoring of Common Indicator 17, by applying relevant statistical methods and available scientific expertise in ensuring the quality of data reported to the IMAP Info System. These data control categories have been integrated into the IMAP Info System as of 2024.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Traditional methods for eutrophication monitoring in coastal waters involve *in situ* sampling/measurements of commonly measured parameters such as nutrients concentration. Concerning available methods for *in situ* measurements, ships provide flexible platforms for eutrophication monitoring, while remote sensing provides opportunities for a synoptic view over regions or sub-regions. Besides traditional ship measurements, ferry-boxes and other autonomous measuring devices have been developed that allow high frequency and continuous measurements.

Sampling for the determination of *in vitro* fluorescence and nutrient analysis may be carried out with relatively little effort if a properly equipped pump and hose system are mounted on the vessel. Measurements may be taken at the surface or just below it using a water intake on the vessel`s hull, at fixed or varying depths with a towed “fish” and pumping system.

Building on elements elaborated in the Integrated Monitoring and Assessment Programme (2016 IMAP), including the above-mentioned components, the Monitoring Guidelines—structured around the specific technical protocols related to IMAP Common Indicators 13 and 14—were comprehensively developed by the MED POL Programme in cooperation with IAEA/MESL. These guidelines were approved by the MED POL Focal Points Meeting (2021).They build upon the knowledge and practices obtained over 40 years of MED POL monitoring implementation and recent publications, highlighting the current practices of the Contracting Parties’ marine laboratories, as well as other Regional Seas Conventions and the EU. A thorough analysis of presently available practices of UNEP/MAP, UNEP and IAEA, as well the HELCOM, OSPAR and European Commission Joint Research Centre was undertaken to assist an innovative approach for preparation of the IMAP Monitoring Guidelines/Protocols. The monitoring methodologies and practices are elaborated for sampling, sample preservation and transportation, sample preparation and analysis, along with quality assurance and reporting of monitoring data, for their use by the IMAP competent laboratories in order to ensure the representativeness and accuracy of the analytical results. These guidelines present a summary of the best available known practices employed in marine monitoring by bringing integrated comprehensive analytical practices that can be applied in order to ensure the representativeness and accuracy of the analytical results needed for generation of quality assured monitoring data.

The Monitoring Guidelines for IMAP Common Indicators 13 and 14 outline the following monitoring and reporting practices:

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)
○ A-1. Monitoring Guidelines/Protocols for Sampling and Determination of Hydrographic Physical and Chemical Parameters; ○ A-2: Guidelines/Protocols for sampling and determination of key nutrients and chlorophyll a in seawater outlines the analytical procedures for the determination of Chlorophyll a and its related sub-indicators; ○ E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20; ○ F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.	
Available data sources IMAP Info System (http://imapinfosystem.info-rac.org/app/#/) EMODNET Chemistry: http://www.emodnet-chemistry.eu/data_access.html EEA Waterbase - Transitional, coastal and marine waters: http://www.eea.europa.eu/data-and-maps/data/waterbase-transitional-coastal-and-marine-waters-11	
Spatial scope guidance and selection of monitoring stations The first factor promoting eutrophication is nutrient enrichment. This explains why the main eutrophic areas are to be found primarily not far from the coast, mainly in areas receiving high nutrient loads, despite some natural symptoms of eutrophication can also be found, such as in upwelling areas. Additionally, the risk of eutrophication is linked to the capacity of the marine environment to confine growing algae in the well-lighted surface layer. The geographical extent of potentially eutrophic waters may vary widely, depending on: (i) the extent of shallow areas, i.e. with depth ≤ 20 m; (ii) the extent of stratified river plumes, which can create a shallow surface layer separated by a halocline from the bottom layer, whatever its depth; (iii) extended water residence times in enclosed seas leading to blooms triggered to a large degree by internal and external nutrient pools; and (iv) upwelling phenomena leading to autochthonous nutrient supply and high nutrient concentrations from deep water nutrient pools, which can be of natural or human origin. Therefore, the geographical scale of monitoring for the assessment of GES for eutrophication will depend on the hydrological and morphological conditions of an area, particularly the freshwater inputs from rivers, the salinity, the general circulation, upwelling and stratification. The spatial distribution of the monitoring stations should, prior to the establishment of the eutrophication status of the marine sub-region/area, be risk-based and proportionate to the anticipated extent of eutrophication in the sub-region under consideration as well as its hydrographic characteristics aiming for the determination of spatially homogeneous areas. The eutrophication monitoring programmes should pursue to assess the eutrophication phenomena, based on the differentiation of the scale and time dependant signals from human induced versus natural eutrophication. As part of the 2023 MED QSR preparation, the assessment scales for CIs 13 and 14 are defined within the framework of the IMAP nested approach, building upon the elements outlined in the section on Assessment of Eutrophication.	
Temporal Scope guidance Flexibility should be incorporated into the design of the monitoring programme to take account of differences in each marine sub-region/area. At the Mediterranean Sea latitudes, in general terms, the pre-summer and winter primary production bloom intensity peaks of natural eutrophication define the strategy for the sampling frequency, although year-round measurements of nutrients may be more appropriate.	

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

The current national eutrophication monitoring programme, developed within the framework of IMAP implementation, has laid the foundation for marine environment monitoring in the Mediterranean. The optimum frequency (seasonal 2 to 4 times per year or monthly 12 times per year) for the monitoring of nutrients at the selected stations should be chosen taking into account the necessity of both to control the deviations of the known natural cycles of eutrophication in coastal areas and the control of (decreasing) trends monitoring impacted areas, therefore, from low frequency (minimum)to high frequency measurements.

Therefore, either for impacted or non-impacted coastal waters the optimal frequency per year and sampling locations needs to be selected at a local scale, whilst for open waters the sampling frequency to be determined on a sub-regional level following a risk-based approach.

Mainly, in order to build a robust sampling frequency scale in future a sounded statistical approach has to be developed that takes into account the discriminant limit between classes when the nutrient boundaries approach will be widely accepted.

Let consider the approach developed for CI14 - Chlorophyll a concentration in water column as an example to be used, as for this CI accepted boundaries exists.

Sampling frequency is determined by the variability of the measured parameters and is usually determined by how many samples are needed to reliably assess the differences between two neighbouring mean values.

Discriminant limit (ie power of applied test), depends on sample size:
Discriminant limit $dM = sd * t(\alpha/2; N1+N2-2) * \sqrt{\ }2; N1+N2-2)$ 0
For Chl-a log10 units for different sample size N with the significance level: $\alpha/2 = 0,025$; with an average sd = 0.30

N = 12 t = 2.074 $\sqrt{\ }$
N = 24 t = 2.013 √ = 24 = 0.289 dM > |0.17|
N = 52 t = 1,983 √ = 52 = 0.196 dM > |0.12|

Based on the above, it follows that a particular area can be characterized best by measuring three relevant depths (typically 0, 5 and 10 m) at one station at least monthly or at three stations one depth (0 m). It is based on 36 samples annually which discriminates approximately 0.15 chla log10 unit for mesotrophic - eutrophic area that is slightly less than half difference between two classes (0.37 as log10 unit). Due to the smaller standard deviation in an oligotrophic area, the same results are achieved with half the frequency. The following sampling frequency is recommended as the guidance taking into account specific local conditions:

- Eutrophic – mesotrophic: monthly,
- Mesotrophic – oligotrophic: monthly near the coast, bimonthly in open waters, and
- Oligotrophic: bimonthly near the coast, seasonally in open waters.

Data analysis and assessment outputs

Despite the individual nutrient concentrations and nutrient ratios are evaluated based on statistical analysis against known reference levels and known marine eutrophication processes, following the evaluation of information provided by a number of countries and other available information, it has to be noted that the Mediterranean countries are using different eutrophication non-mandatory assessment methods such as TRIX, UNTRIX, Eutrophication scale, EI, HEAT, OSPAR, etc. Nutrients concentrations are part of these tools and is very important to continue to be used at sub-regional or national levels because there is a long-term experience within countries which can reveal / be used for assessing eutrophication trends. As part of the preparation for the 2023 MED QSR, the most relevant

Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)

and applicable methods for eutrophication assessment were explored, developed, and applied, as outlined in the following section. Further advancements in eutrophication assessment should address the gaps identified during the 2023 MED QSR process to enhance coherency and comparability regarding of eutrophication assessment methodologies.

Assessment Criteria

As part of the preparation for the 2023 MED QSR, updated reference and boundary values were provided for Chlorophyll a. Additionally, new reference and boundary values were developed for Total Phosphorus (TP) and Dissolved Inorganic Nitrogen (DIN), as adopted by Decision 26/3 (COP23) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean (Table 1 below). However, due to insufficient data from other sub-regions, assessment criteria for DIN and TP were not established outside the Adriatic Sea Sub-region.

Table 1. Coastal water types in the Mediterranean, along with the new reference conditions and boundary values for Total Phosphorous (TP) and Dissolved Inorganic Nitrogen (DIN) for coastal and open (offshore) waters in the Adriatic Sea Sub-region.
Reference conditions and boundary (Good/Moderate status) values are based on long time series (>5 years) of monthly sampling at least.

	Coastal waters	
	Reference conditions of *c*(TP) (µmol/L)	**Boundaries of *c*(TP) (µmol/L) for G/M status**
Water Typology		
Type I		
Type I Adriatic	0,19 [a]	0,55 [a]
Type II-A-FR-SP[d]	-	-
Type II-A Adriatic	0,16 [a]	0,48 [a]
Type II-A[e] Tyrrhenian	-	-
Type III-W Adriatic[c]	-	0,26
Type III-W Tyrrhenian	-	-
Type III-W-FR-SP		
Type III-E		
Type Island-W		

	Open (offshore) waters in the Adriatic Sea Sub-region	
	Reference conditions of *c*(DIN) (µmol/L)	**Boundaries of *c*(DIN) (µmol/L) for G/M status**
Water Typology		
Type I Adriatic	0,21[g]; 0,66[h]	22.3
Type II-A Adriatic	-	-
Type III-W Adriatic [c]	-	-

[a] *From Giovanardi et al, 2018*
[c] *The ecological classification scheme would not be suitable for proper and safe classification, and therefore the boundary values for WT III-W Adriatic waters are based on the H/G values for WT II-A Adriatic in coastal waters i.e. 0.64 µg/L for Chla and 0,26 µmol/L for TP*
[d] *Correction of error included to ensure consistency with the classification as provided in Commission Decision 2013/480/EU i.e. Type II -FR-SP, as included in Decision IG.22/7, replaced with Type II -A-FR-SP*
[e] *Correction of error included to ensure consistency with the classification as provided in Commission Decision 2013/480/EU i.e., Type II-A Tyrrhenian replaced Type II-B Tyrrhenian, as included in Decision IG.22/7, since the latter does not exist in the Tyrrhenian Sea*

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[g] for ME; [h] for HR, IT
[h] No pressure – effect relationship was found, and therefore RC for DIN and boundary G/M values for Chla and DIN could not be proposed.

Ongoing efforts focus on establishing the new reference and boundary values for Total Phosphorus (TP) and Dissolved Inorganic Nitrogen (DIN), and the updated reference and boundary values, where applicable, for Chlorophyll a (Chl *a*), in the selected pilot sub-region(s)/sub-division(s), depending on data availability.

Assessment of Eutrophication

As suggested by the on-line expert group on eutrophication established by the Contracting Parties it is recommended that with regard to nutrient concentrations, until commonly agreed thresholds have been determined and agreed upon, GES may be determined on a levels and trend monitoring basis.

The assessment methodologies for eutrophication, as developed and applied for the preparation of the 2023 MED QSR, are detailed in the IMAP Guidance Factsheet for IMAP CI 14. Due to the limited data available for nutrients, an integrated NEAT GES assessment was applied for CIs 13 and 14, focusing on total phosphorus and dissolved inorganic nitrogen along with Chlorophyll a in the Adriatic Sea Sub-region.

Known gaps and uncertainties in the Mediterranean

Nutrient, transparency and oxygen thresholds and reference values may not be identical for all areas, since it is recognized that area-specific environmental conditions must define threshold values. GES could be defined on a sub-regional level, or on a sub-division of the sub-region (such as the Northern Adriatic), due to local specificities in relation to the trophic level and the morphology of the area.

Further to the significant progress achieved over the last few biennia regarding the standardizing monitoring practices and establishing Good Environmental Status (GES) and environmental assessment tools—along with the improved availability of assessment criteria – it is essential—, for a complete assessment of eutrophication and the achievement of GES, to define GES thresholds and reference conditions (natural background concentrations) not only for chlorophyll *a*, but also for total phosphorus (TP) and dissolved inorganic nitrogen (DIN) across all sub-regions. This should build on the relevant experience gained in setting reference and boundary values for these nutrients in the Adriatic Sea Sub-region,as minimum requirements. This process should include quality assurance schemes, as well as data quality control protocols. The progress in establishing reference and boundary values for total phosphorus (TP) and dissolved inorganic nitrogen (DIN) is outlined in the section above.

By building on the achievements up to 2023, during the preparation of the 2023 MED QSR, several knowledge gaps were identified in the monitoring and assessment of Common Indicators 13 and 14, which need to be addressed following the recommendations of the 2023 MED POL Focal Points Meeting, as outlined in the Guidance Factsheet for IMAP CI 14.

Contacts and Version Date

http://www.unepmap.org

Version No	**Date**	**Author**
V.1	31.5.17	MEDPOL
V.2	10.1.19	MEDPOL
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Indicator Title	Common Indicator 13. Concentration of key nutrients in water column (EO5)	
Final version	09/09/2019	Approved by the 7th Meeting of EcAp Coordination Group
V4	28/05/2025	Joint CorMon Pollution and ML Meeting
V5		Approved by the Meeting of MED POL FPs
Final version		Approved by the 12th Meeting of EcAp Coordination Group

7. The revision of IMAP **Common Indicator 14 (EO5)**: "Chlorophyll a concentration in water column" is presented in the table bellow.

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)[3]**
Natural levels of algal biomass, water transparency and oxygen concentrations in line with prevailing physiographic, geographic and weather conditions	Direct and indirect effects of nutrient over-enrichment are prevented	State: • Chlorophyll a concentration in high-risk areas below the boundary limit between GES and non-GES classes of the assessment scales. • Decreasing trend in Chl-a concentrations in high-risk areas affected by human activities. • Index of turbidity below the boundary limit between GES and non-GES classes of the assessment scales to be set upon defining the turbidity assessment criteria [4]. • Increasing trend of transparency in areas impacted by human activities[5]. • Dissolved oxygen concentrations in high-risk areas below the boundary limit between GES and non-GES

[3] Following the decisions to be made at the present meeting regarding minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3/Rev.1, the revised Targets will be incorporated into the revised IMAP Pollution Indicators Factsheets.
[4] Transferred from Indicator 5.2.2, Decision IG. 21/3, Annex I
[5] ibidem

<table>
<tr><th>Indicator Title</th><th colspan="2">Common Indicator 14. Chlorophyll a concentration in water column (EO5)</th></tr>
<tr><td></td><td></td><td>classes of the assessment scales to be set upon defining the oxygen concentrations assessment criteria [6].
• Increasing trend in dissolved oxygen concentrations in areas impacted by human activities[7].</td></tr>
<tr><td colspan="3">Rational</td></tr>
<tr><td colspan="3">Justification for indicator selection

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)[8]. The consequences of eutrophication are undesirable if they appreciably degrade ecosystem health and/or the sustainable provision of goods and services, such as excessive algal blooms, dissolved oxygen deficiency, declines in sea-grasses, mortality of benthic organisms and/or fish. Although, these changes may also occur due to natural processes, the management concern begins when they are attributed to anthropogenic sources.

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.</td></tr>
<tr><td colspan="3">Scientific References

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</table>

[6] Transferred from Indicator 5.3.1, Decision IG. 21/3, Annex I
[7] ibidem
[8] IMAP (2017) Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria, UN Environment/MAP Athens, Greece, pp 52.

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

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Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

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Policy Context and Targets

Policy context description

In the Mediterranean, the UNEP/MAP MED POL Monitoring programme included from its inception the study of eutrophication as part of its seven pilot projects approved by the Contracting Parties at the Barcelona meeting in 1975 (UNEP MAP, 1990a,b). The issue of a consistent monitoring strategy and assessment of eutrophication was first raised at the UNEP/MAP MED POL National Coordinators Meeting in 2001 (Venice, Italy) which recommended to the Secretariat to elaborate a draft programme for monitoring of eutrophication in the Mediterranean coastal waters (UNEP/MAP MED POL, 2003). In spite of a series of assessments reviewing the concept and state of eutrophication, there are important gaps in the capacity to assess the intensity of this phenomenon. Efforts have been devoted to defining the concepts to assess the intensity and to extend experience beyond the initial sites in the Adriatic Sea, admittedly, the most eutrophic area in the entire Mediterranean Sea. In the context of the Mediterranean Sea, the monitoring and assessment of eutrophication were redefined in accordance with the Integrated Monitoring and Assessment Programme (UNEP/MAP, 2016). This redefinition ensures synergy with the European Marine Strategy Framework Directive (200/56/EC). The Data Dictionaries and Standards for IMAP Common Indicators 13 and 14 (2019, http://imapinfosystem.info-rac.org/app/#/standard), aligned with the IMAP Guidance Factsheets, defined the list of mandatory datasets, including physico-chemical parameters, to provide an integrated assessment of eutrophication.

Targets

As part of the preparation for the 2023 MED QSR eutrophication assessment, the following two assessment scales have been established and applied in the Mediterranean sub-regions to assess the Good Environmental Status (GES), as applicable:

- The Scale of NEAT (Nested Environmental Status Assessment Tool) Integrated Assessment of CIs 13&14

- The five-class assessment scale was applied to the data reported by countries for dissolved inorganic nitrogen (DIN), total phosphorus (TP), and chlorophyll-a (Chl-a), enabling their use in calculating assessment criteria for the sub-divisions of the Adriatic Sea sub-regions.
- The five-classes of assessment —High, Good, Moderate, Poor, and Bad—were established, with two boundary limit values that define the scale: i) the Reference Conditions (RC), representing the best conditions (High), and ii) the maximum parameter concentration (i.e., DIN, TP, and Chl-a), representing the worst conditions (Bad). Additionally, a threshold value for the GES/non-GES boundary is defined.

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

- The decision rule for determining GES/non-GES status is based on comparing score values against the boundary limit defined by the Good/Moderate (G/M) threshold, which distinguishes between the Good and Moderate classes.
- NEAT values range from 0 to 1 and represent the overall status assessment for each parameter, or the integrated assessment of multiple parameters based on the five-class scale. Average concentrations are calculated using geometric means, along with their respective geometric standard deviations and standard errors of the geometric mean. Threshold concentrations are normalized to a scale from 0 to 1 as follows:

  $0 \leq$ bad $< 0.2 \leq$ poor $< 0.4 \leq$ moderate $< 0.6 \leq$ good $< 0.8 \leq$ high ≤ 1
- The status of class is determined by the linear distance of score values from the two boundary limits: the Reference Conditions and the maximum parameter concentrations, as well as the GES/non-GES threshold. GES status is assigned for values below 0.6, while non-GES status applies to values above 0.6.

NEAT Integrated Assessment of CIs 13&14	**GES**			**non-GES**		
	RC	**High**	**Good**	**Moderate**	**Poor**	**Bad**
Boundary Limits and Normalized NEAT Values	<RC/H limit, not in score scale	1<Score≤0.8	0.8<Score≤0.6	0.6<Score≤0.4	0.4<Score≤0.2	Score≤0.2
Good/non-Good			**G/**	**M**		

The Scale of Simplified Assessment of Chlorophyll a (IMAP Common Indicator 14)

- This scale was applied to satellite-derived Chlorophyll-a (Chl-*a*) data points to enable their use in calculating assessment criteria for the sub-divisions of the Aegean-Levantine Sea, the Central Mediterranean Sea, and the Western Mediterranean Sea sub-regions.
- The introduction of satellite-derived Chl-a as a supplementary assessment parameter ~~new assessment parameter,~~ alongside *in situ* Chl-a data necessitates the statistical calculation of a ~~new~~ set of assessment criteria, in cases where Contracting Parties have not reported proven relationship between *in situ* Chl-a and satellite-derived data, ~~as there is no established relationship between satellite-derived Chl-a data and in situ measurements based on the effects-pressures relationship~~.
- The data were aggregated as a five-year geometric mean and normalized to ensure comparability across the assessed areas. For normalization, the bestNormalize package in R was used, identifying the Ordered Quantile Normalizing Transformation as the most suitable method (Bartlett, 1947; Beasley et al., 2009).
- The GES/non-GES decision rule is established by comparing the calculated value to a boundary limit defined by the Good/Moderate (G/M) threshold. This threshold is set at the 85th percentile of the normalized distribution of calculated values, which is approximately equal to the mean plus one standard deviation (~mean +1 SD). In this distribution, the 50th percentile represents the mean value, while the 25th percentile corresponds to the mean value in heavily impacted areas.
- The reference conditions (RC) values were calculated from the normalized values and were represented by the 10th percentile.
- Values above the boundary limit are classified as GES, while values below the boundary limit are considered non-GES.
- By selecting the 85th percentile of the normalized distribution of calculated values as the G/M boundary limit, the classification compatibility is ensured for the application of the Simplified Assessment Methodology and the five-class GES/non-GES scale, as established for the NEAT GES assessment.

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

- In cases where discrepancies arise between the regional assessment results based on statistically derived satellite data and national assessments utilizing *in situ* data and nationally developed assessment scales, the findings of national assessments should also be considered—provided they are supported by a scientifically-evidenced justification from national experts.

Simplified Assessment of CI 14	**GES**		**non-GES**
Boundary Limits*	$\leq 10^{th}$ % (RC)	$>10^{th}$ % CHL_GM $\leq 85^{th}$ %	CHL_GM.$>85^{th}$ %
Good/non-Good		**G/**	**M**

***Percentiles are calculated from the normalized annual geometric mean (using Ordered Quantile transformation) over a minimum period of five years**

Further details can be found in thematic eutrophication assessments and the 2023 MED QSR Pollution Assessments, as presented and approved by the Integrated Meeting of the Ecosystem Approach Correspondence Groups (CORMONs), held in Athens, Greece, on 27–28 June 2023.

Policy documents

General Policy documents

Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets.

Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027.

Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.

Decision IG.24/4 (COP21, 2019) on Assessment Studies.

Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.

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

UNEP(DEC)/MED WG.372/3. (2012) Approaches for definition of GES and setting targets for the pollution related ecological objectives in the framework of the ecosystem approach. (EO5: eutrophication, EP9: contaminants, EP10: marine litter, EO11: noise).

UNEP(DEPI)/MED IG.22/Inf.7. (2016) Integrated Monitoring and Assessment Guidance

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

2017 Mediterranean Quality Status Report, https://www.medqsr.org/node/10/

2023 Mediterranean Quality Status Report, medqsr2023.info-rac.org

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

Commission Directive (EU) 2017/845 of 17 May 2017 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies.

Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardized methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

Eutrophication related Policy documents

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

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

UNEP/MED WG.463/Inf.9 (2019). Example of overall interrelationships between the IMAP and the DPSIR framework applied to the coastal and marine ecosystem. Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring.

UNEP/MED WG.509/10//Rev.2, (2021) Integration and Aggregation Rules for Monitoring and Assessment of (IMAP Pollution and Marine Litter Cluster).

UNEP/MED WG 533/ 4. (2022) Assessment Criteria Methodologies for IMAP Common Indicator 13: Reference and Boundary Values for DIN and TP in the Adriatic Sea Sub-region.

UNEP/MED.WG.550/10/Rev.1, (2023), 2023 Med QSR: The IMAP Pollution Cluster Chapters; Thematic Assessments.

UNEP/MED.WG.550/Inf.13 (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Assessment Results of IMAP Common Indicators 14 in the Central Mediterranean Sea Sub-region by Applying the Simplified G/M Assessment Methodology.

UNEP/MED WG.556/Inf.3/Rev.1. (2023), The Results of GES Assessment for IMAP Common Indicators 13 and 14 in the Adriatic Sea Sub-region by Applying the NEAT GES Assessment Methodology.

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)
UNEP/MED WG.556/Inf.4/Rev.1. (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Assessment Results of IMAP Common Indicators 13&14 in the Aegean - Levantine Sea Sub-region by Applying the Simplified G/M Assessment Methodology. UNEP/MED WG.556/Inf.5/Rev.1. (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Assessment Results of IMAP Common Indicators 13&14 in the Western Mediterranean Sea Sub-region by Applying the Simplified G/M and EQSR Assessment Methodologies. UNEP/MED WG.556/Inf.16/Rev.1. (2023), 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 Adritic Sea Sub-region.	
Indicator analysis methods	
Indicator Definition Chlorophyll *a* concentration in the water column (State, Impact Indicator); Sub-Indicators: Water Transparency (State, Impact Indicator) and Dissolved oxygen (State, Impact Indicator) The list of all chemical and related parameters subject to reporting for IMAP CI 14 by the Contracting Parties is elaborated in the Data Standards for IMAP CI 14.	
Methodology for indicator calculation Chlorophyll *a*: Spectrophotometry. ISO 10260 (1992) on spectrometric determination of the chlorophyll *a* concentration provides a standard method for quantification of chlorophyll *a*. Water transparency: measured as Secchi disk depth or according to ISO 7027:1999 Water Quality-Determination of Turbidity Dissolved Oxygen: Chemical methods, Oxygen sensors, etc. measured near the bottom (under the euphotic layer/oxycline) The detailed analytical procedure for Chlorophyll *a* and other related mandatory parameters, including sampling and sample transportation, analytical determination of indicators and sub-indicators, data quality control are outlined in A-2: Guidelines/Protocols for sampling and determination of key nutrients and chlorophyll a in seawater outlines the analytical procedures for the determination of Chlorophyll a and its related sub-indicators.	
Indicator units microgram per liter (µg/L) - Chlorophyll *a* meters – Secchi disk depth; NTU Turbidity Scale (Nephelometric Turbidity Units) – Water transparency milligram per liter (mg/L) and % Saturation (if temperature and salinity is known) – Dissolved Oxygen Data Standards for IMAP CI 14 elaborates units for all mandatory parameters.	
List of Guidance documents and protocols available IMAP Monitoring Guidelines/Protocols (https://www.iaea.org/about/organizational-structure/department-of-nuclear-sciences-and-applications/division-of-iaea-environment-laboratories/marine-environmental-studies-laboratory/unep-map-med-pol-integrated-monitoring-and-assessment-programme-imap-monitoring-guidelines):	

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

- A-1. Monitoring Guidelines/Protocols for Sampling and Determination of Hydrographic Physical and Chemical Parameters;
- A-2: Guidelines/Protocols for sampling and determination of key nutrients and chlorophyll a in seawater outlines the analytical procedures for the determination of Chlorophyll a and its related sub-indicators;
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.

Data Confidence and uncertainties

Despite the great variability in water layers affected by active hydrodynamic processes, monitoring seawater characteristics remains the most direct method for assessing eutrophication. Several key parameters have been identified as providing valuable information related to eutrophication e.g. chlorophyll *a*, dissolved oxygen, inorganic nutrients, organic matter, suspended solids, light penetration, aquatic macro-phytes, zoo benthos, etc. They all may be determined either at the surface or at various depths.

If only limited means are available, determination of those parameters that synthesize the most information should be retained. For example, Chlorophyll *a* determination may not offer very precise representations of the system, although it provides valuable insights. Turbidity may also be a good measure of eutrophication, although caution is needed near river mouths, where inert suspended solids may be extremely abundant. Dissolved oxygen is a parameter that integrates a wide range of information on the processes involved in eutrophication, especially when measured near the bottom or, at least, below the euphotic zone, where an oxycline usually appears.

An external quality assurance by performing regional interlaboratory QA/QC exercises has been organized for contaminants in collaboration of the UNEP/MAP - MED POL and the IAEA/MESL since 1986. As of 2024, the IAEA/MESL, the scope of proficiency testing and training courses has been expanded to support the capacities of national laboratories in monitoring eutrophication (IMAP Common Indicators 13 & 14: inorganic nutrients in high salinity seawater, in estuarine and low salinity seawater, and chlorophyll a and Phaeopigments in Seawater) and contaminants in seafood (IMAP Common Indicator 20: heavy metals, polycyclic aromatic hydrocarbons (PAHs), dioxins, and PCBs).

In addition, the data quality control range categories were initially established for physico-chemical parameters related to the monitoring of IMAP Common Indicators 13 and 14, as well as for contaminants related to the monitoring of Common Indicator 17, by applying relevant statistical methods and available scientific expertise in ensuring the quality of data reported to the IMAP Info System. These data control categories have been integrated into the IMAP Info System as of 2024.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Traditional methods for eutrophication monitoring in coastal waters involve *in situ* sampling/measurements of commonly measured parameters such as nutrients concentration, chlorophyll *a* concentration, phytoplankton abundance and composition, transparency and dissolved oxygen concentration. Concerning available methods for *in situ* measurements, ships provide flexible platforms for eutrophication monitoring, while remote sensing provides opportunities for a synoptic view over regions or sub-regions. Besides traditional ship measurements, ferry-boxes and other autonomous measuring devices have been developed that allow high frequency and continuous measurements.

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)

Modelling and remote sensing should also be considered as complementary, area-integrating approaches alongside in situ measurements, depending on data requirements

Modelling and remote sensing should also be considered as complementary, area integrating in addition to *in situ* measurements, depending on data requirements. In general, *in situ* measurements always remain necessary to validate and calibrate the models and data calculated from satellite measurements. However, the use of satellite-derived data need to be considered as the proven supplementary modality to the *in situ* data. A good strategy appears to be a combination of remote sensing with on-site scanning using automatic measuring instruments such as thermo-salinometer, dissolved oxygen sensors and *in vivo* fluorometer and/or nephelometer. Sampling for the determination of *in vitro* fluorescence and nutrient analysis may be carried out with relatively little effort if a properly equipped pump and hose system are mounted on the vessel. Measurements may be taken at the surface or just below it using a water intake on the vessel`s hull, at fixed or varying depths with a towed "fish" and pumping system.

Building on elements elaborated in the Integrated Monitoring and Assessment Programme (2016 IMAP), including the above-mentioned components, the Monitoring Guidelines—structured around the specific technical protocols related to IMAP Common Indicators 13 and 14—were comprehensively developed by the MED POL Programme in cooperation with IAEA/MESL. These guidelines were approved by the MED POL Focal Points Meeting (2021).They build upon the knowledge and practices obtained over 40 years of MED POL monitoring implementation and recent publications, highlighting the current practices of the Contracting Parties' marine laboratories, as well as other Regional Seas Conventions and the EU. A thorough analysis of presently available practices of UNEP/MAP, UNEP and IAEA, as well the HELCOM, OSPAR and European Commission Joint Research Centre was undertaken to assist an innovative approach for preparation of the IMAP Monitoring Guidelines/Protocols. The monitoring methodologies and practices are elaborated for sampling, sample preservation and transportation, sample preparation and analysis, along with quality assurance and reporting of monitoring data, for their use by the IMAP competent laboratories in order to ensure the representativeness and accuracy of the analytical results. These guidelines present a summary of the best available known practices employed in marine monitoring by bringing integrated comprehensive analytical practices that can be applied in order to ensure the representativeness and accuracy of the analytical results needed for generation of quality assured monitoring data.

The Monitoring Guidelines for IMAP Common Indicators 13 and 14 outline the following monitoring and reporting practices:

- A-1. Monitoring Guidelines/Protocols for Sampling and Determination of Hydrographic Physical and Chemical Parameters;
- A-2: Guidelines/Protocols for sampling and determination of key nutrients and chlorophyll a in seawater outlines the analytical procedures for the determination of Chlorophyll a and its related sub-indicators;
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.

Available data sources
IMAP Info System (http://imapinfosystem.info-rac.org/app/#/)
EMODNET Chemistry:
http://www.emodnet-chemistry.eu/data_access.html

EEA Waterbase - Transitional, coastal and marine waters:
http://www.eea.europa.eu/data-and-maps/data/waterbase-transitional-coastal-and-marine-waters-11

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)
Satellite databases such as in EMIS (http://mcc.jrc.ec.europa.eu/emis/), COPERNICUS, ARGANS France, and the SMED algorithm	
Spatial scope guidance and selection of monitoring stations The extent of eutrophication shows spatial variation, for instance coastal areas versus the open sea. The frequency and spatial resolution of the monitoring programme should reflect this spatial variation in eutrophication status and pressures following a risk-based approach and the precautionary principle. The geographical extent of potentially eutrophic waters may vary widely, depending on: (i) the extent of shallow areas, i.e. with depth ≤ 20 m; (ii) the extent of stratified river plumes, which can create a shallow surface layer separated by a halocline from the bottom layer, whatever its depth (iii) extended water residence times in enclosed seas leading to blooms triggered to a large degree by internal and external nutrient pools; and (iv) upwelling phenomena leading to autochthonous nutrient supply and high nutrient concentrations from deep water nutrient pools, which can be of natural or human origin. Therefore, the geographical scale of monitoring for the assessment of GES for eutrophication depends on the hydrological and morphological conditions of an area, particularly the freshwater inputs from rivers, the salinity, the general circulation, upwelling and stratification. The spatial distribution of the monitoring stations should, prior to the establishment of the eutrophication status of the marine sub-region/area, be risk-based and proportionate to the anticipated extent of eutrophication in the sub-region under consideration as well as its hydrographic characteristics aiming for the determination of spatially homogeneous areas. The eutrophication monitoring programmes should pursue to assess the eutrophication phenomena, based on the differentiation of the scale and time dependant signals from human induced versus natural eutrophication. As part of the 2023 MED QSR preparation, the assessment scales for CIs 13 and 14 are defined within the framework of the IMAP nested approach, building upon the elements outlined in the section on Assessment of Eutrophication.	
Temporal Scope guidance The current national eutrophication monitoring programme, developed within the framework of IMAP implementation, has laid the foundation for marine environment monitoring in the Mediterranean. Sampling frequency has to be determined by the variability of the measured parameters and is usually determined by how many samples are needed to reliably assess the differences between two neighbouring mean values. Discriminant limit (i.e. power of applied test), depends on sample size: Discriminant limit $dM = sd * t(\alpha/2; N1+N2-2) * \sqrt{(1/N1+1/N2)} \neq 0$ For Chl-a log10 units for different sample size N with the significance level: $\alpha/2 = 0{,}025$; with an average sd = 0.30 $N = 12\ t = 2.074\ \sqrt{(2/12)} = 0.408\ dM > \|0.25\|$ $N = 24\ t = 2.013\ \sqrt{(2/24)} = 0.289\ dM > \|0.17\|$ $N = 52\ t = 1{,}983\ \sqrt{(2/52)} = 0.196\ dM > \|0.12\|$ Based on the above, it follows that a particular area can be characterized best by measuring three relevant depths (typically 0, 5 and 10 m) at one station at least monthly or at three stations one depth	

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(0 m). It is based on 36 samples annually which discriminates approximately 0.15 chla log10 unit for mesotrophic - eutrophic area that is slightly less than half difference between two classes (0.37 as log10 unit). Due to the smaller standard deviation in an oligotrophic area, the same results are achieved with half the frequency. The following sampling frequency is recommended as the guidance taking into account specific local conditions:

- Eutrophic – mesotrophic: monthly,
- mesotrophic – oligotrophic: monthly near the coast, bimonthly in open waters, and
- oligotrophic: bimonthly near the coast, seasonally in open waters.

For open waters sampling frequency should be determined on a sub-regional level following a risk-based approach:

- Water transparency: *id.* Chlorophyll *a*
- Dissolved Oxygen: *id.* Chlorophyll *a*

Data analysis and assessment outputs

Statistical Analysis and Basis for Aggregation – Water Typology and Assessment Criteria

The classification scheme on chlorophyll *a* concentration developed by MEDGIG as an assessment method easily applicable by all Mediterranean countries based on the indicative thresholds and reference values adopted. The water types for applying eutrophication assessment are based on hydrological parameters characterizing a certain area dynamics and circulation.

The main statistical analysis is based on the typology criteria and settings derived from the analysis of influence of freshwater inputs as the main nutrient drivers. More information on is presented in document the UNEP(DEPI)/MED WG 417/Inf.15. Three main types were identified:

Type I	coastal sites highly influenced by freshwater inputs,
Type IIA	coastal sites moderately influenced not directly affected by freshwater inputs (Continent influence),
Type IIIW	continental coast, coastal sites not influenced/affected by freshwater inputs (western Basin),
Type IIIE	not influenced by freshwater input (Eastern Basin),
Type Island	coast (western Basin).

Coastal water type III was split in two different sub basins, the western and the Eastern Mediterranean s, according to the different trophic conditions and is well documented in literature. It is recommended to define the major coastal water types in the Mediterranean for eutrophication assessment (Table 1).

Table 1. Major coastal water types in the Mediterranean

	Type I	Type IIA, IIA Adriatic	Type IIIW	Type IIIE	Type Island-W
σt (density)	<25	25<d<27	>27	>27	All range
Salinity	<34.5	34.5<S<37.5	>37.5	>37.5	All range

With the view to assess eutrophication, it is recommended to rely on the classification scheme on Chlorophyll a concentration (μg L-1) in coastal waters as a parameter easily applicable by all Mediterranean countries based on the indicative thresholds and reference values presented in Table 2. The above table of major coastal water types is also indicative of the part of offshore waters next to coastal waters; however, it should be used with caution in the offshore (open) areas.

In preparation for the 2023 MED QSR, updated reference and boundary values for Chlorophyll a were provided, as adopted by Decision 26/3 (COP23) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean (Table 2 below).

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Table 2. Coastal water types reference conditions and boundary values for Chlorophyll a in the Mediterranean, along with the new and updated values for coastal and open (offshore) waters in the Adriatic Sea Sub-region.

(Shaded cells indicate the criteria which remain as provided in Decision IG.22/7 (COP 20, 2019). Unshaded cells represent the new criteria adopted in Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean. Reference conditions and boundary (Good/Moderate status) values are based on long time series (>5 years) of monthly sampling at least, which differ from type to type on the sub-regional scale, and therefore, were built with different strategies). The blue-marked cells display the G_mean values of reference and boundary values, expressed as the 90th percentile, as adopted in Decision 26/3.

	Coastal waters			
	Reference conditions of *c*(Chl*a*) (µg/L)		**Boundaries of *c*(Chl*a*) (µg/L) for G/M status**	
Water Typology	*G_mean*	90% percentile	*G_mean*	90% percentile
Type I	1.19	3,33[b]	4,1	10[b]
Type I Adriatic	1,40	3,94	5,0[a]	14,1
Type II-A-FR-SP[d]	0,78[9]	1,9	1,48	3,50[10]
Type II-A Adriatic	0,33	0,87	1,5	4,0
Type II-A[e] Tyrrhenian	0,32	0,77	1,2	2,9
Type III-W Adriatic[c]	-	-	0,64[f]	1,7[f]
Type III-W Tyrrhenian	-	-	0,48	1,17
Type III-W-FR-SP	0,37	0,9	0,74]	1,89[11]
Type III-E		0,1		0,4
Type Island-W		0,6		1,2-1,22

	Open (offshore) waters in the Adriatic Sea Sub-region			
	Reference conditions of *c*(Chl*a*) (µg/L)		**Boundaries of *c*(Chl*a*) (µg/L) for G/M status**	
Water Typology	*G_mean*	90 % percentile	*G_mean*	90 % percentile
Type I Adriatic	0,15[g]; 0,29[h]	0,42[f]; 0,81[g]	3,1	8,7
Type II-A Adriatic	0.11	0.29	-	-
Type III-W Adriatic [c]	-	-	0.64	1.7

a From Giovanardi et al, 2018
b Applicable to Golf of Lion Type I coastal waters

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[9] Gmean values corresponding to the reference and boundary values of Chla (expressed as the 90th percentile) are provided for Type II A FR SP and Type III W FR SP, along with corrected Gmean values for Type I, compared to those included in Decisions IG.22/7 and IG.26/3.

[10] The value of 3.58 µg/L is corrected to 3.50 µg/L for Type II A FR SP in comparison to the values provided in Decision IG.22/7 on Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (COP 19, 2016) and Decision IG.26/3 on 2023 MED QSR and a Renewed Ecosystem Approach Policy in the Mediterranean (COP 23, 2023), following the identification of an error by the Joint Meeting of CorMon on Pollution and Marine Litter Monitoring held on 27–28 May 2025 concerning the boundary values used in the 2023 MED QSR.

[11] The value of 1.80 µg/L is corrected to 1.89 µg/L for type III W FR SP in comparison to the values provided in Decisions IG.22/7 and Decision IG.26/3, following the identification of an error by the Joint Meeting of CorMon on Pollution and Marine Litter Monitoring held on 27–28 May 2025 concerning the boundary values used in the 2023 MED QSR.

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c The ecological classification scheme would not be suitable for proper and safe classification, and therefore the boundary values for WT III-W Adriatic waters are based on the H/G values for WT II-A Adriatic in coastal waters i.e. 0.64 µg/L for Chla and 0,26 µmol/L for TP
d Correction of error included to ensure consistency with the classification as provided in Commission Decision 2013/480/EU i.e. Type II -FR-SP, as included in Decision IG.22/7, replaced with Type II -A-FR-SP
e Correction of error included to ensure consistency with the classification as provided in Commission Decision 2013/480/EU i.e., Type II-A Tyrrhenian replaced Type II-B Tyrrhenian, as included in Decision IG.22/7, since the latter does not exist in the Tyrrhenian Sea
f values based on the H/G values for WT II-Ac The ecological classification scheme would not be suitable for proper and safe classification, and therefore the boundary values for WT III-W Adriatic waters are based on the H/G values for WT II-A Adriatic in coastal waters i.e. 0.64 µg/L for Chla and 0,26 µmol/L for TP
g for ME; h for HR, IT
h No pressure – effect relationship was found, and therefore RC for DIN and boundary G/M values for Chla and DIN could not be proposed.

The geometric mean (*Gmean)* calculation procedure assumes the lognormal distribution of chlorophyll a data:

$$\text{Chl-a } 90\text{th } \textit{percentile}\ _{(\text{expected})} = 10^{(log10(\text{Chl-a } G.mean)+1.282\ sd)}$$

where 1.282 is the value assumed by the standard normal variable zc for which P(z>zc)=10%.

In this context, the 90th percentile should not be considered a true alternative to the geometric mean, as it represents a percentile value derived from the same theoretical normal distribution of log-transformed chlorophyll a data, converted back into a number scale.

Regarding the standard deviation (SD) value, an analysis by Giovanardi et al. (2018) of long-term chlorophyll a data series—conducted in accordance with OECD recommendations (Vollenweider and Kerekes, 1982)—found that standard deviations of the $\log_{10}$-transformed chlorophyll a sample distributions ranged from 0.30 to 0.35 across all water types. Specifically:

- For Type I, SD is approximately 0.35.
- For Type II Adriatic and Type III W Adriatic, SD is around 0.33.
- For Type II Tyrrhenian and Type III W Tyrrhenian, SD is about 0.30.

Developments within the European MSFD with regard to eutrophication should also be taken into account.
It has to be noted that the Mediterranean countries are using different eutrophication non-mandatory assessment methods such as TRIX, UNTRIX, Eutrophication scale, EI, HEAT, OSPAR, etc. These tools are very important to continue to be used at sub-regional or national levels because there is a long-term experience within countries which can reveal / be used for assessing eutrophication trends. As part of the preparation for the 2023 MED QSR, the most relevant and applicable methods for eutrophication assessment were explored, developed, and applied, as outlined in the following section, Further advancements in eutrophication assessment should address the gaps identified during the 2023 MED QSR process. Ongoing efforts focus on establishing the new reference and boundary values for Total Phosphorus (TP) and Dissolved Inorganic Nitrogen (DIN), and the updated reference and boundary values, where applicable, for Chlorophyll a (Chl a), in the selected pilot sub-region(s)/sub-division(s), depending on data availability.

to enhance coherency and comparability of eutrophication assessment methodologies.

Assessment of Eutrophication
GES thresholds and trends are recommended to be used in a combination, depending on data availability and agreement on GES threshold levels. Within the framework of UNEP/MAP MED POL

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there is existing experience in applying the quantitative thresholds. As outlined in Targets section above, it is proposed that for the Mediterranean region quantitative thresholds between “good” (GES) and “moderate” (non-GES) conditions for coastal waters be established and applied for assessment of eutrophication in the 2023 MED QSR. . According to the conclusions of the 2022 Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring, the classification scheme rely on boundary and reference values of chlorophyll *a*, Dissolved Inorganic Nitrogen (DIN) and Total Phosphorous (TP) concentrations in coastal waters as these parameters are easily applicable by all Mediterranean countries.

For the eutrophication assessment conducted as part of the preparation of the 2023 MED QSR, different assessment methodologies were employed for the evaluation of CIs 13 and 14, based on the data availability provided by the Contracting Parties (CPs) across the four Mediterranean Sub-regions. The Mediterranean Sea is divided into four main sub-regions based on available database sources to facilitate the development of pollution assessment criteria. This process began with the preparation of the UNEP/MAP 2011 Initial Integrated Assessment, followed by the Med QSR 2017, and most recently, the 2023 MED QSR assessments. These sub-regions are: the Western Mediterranean, the Adriatic Sea, the Central Mediterranean, and the Aegean and Levantine Seas.

An integrated NEAT GES assessment for CIs 13 and 14 across all sub-regions was not feasible due to the high heterogeneity of data types, spatial coverage, and the lack of quality-assured, homogeneous data. As a result, the NEAT methodology was applied to the Adriatic Sea Sub-region, based on the monitoring areas defined by the concerned CPs and the harmonization of scale approaches among the Contracting Parties. In the absence of reported *in situ* data for the Western, Central Mediterranean, and Aegean and Levantine Seas Sub-regions, satellite-derived data on Chlorophyll-a concentrations from COPERNICUS, ARGANS France, and the SMED algorithm were used as substitutes.

The NEAT assessment methodology strikes a balance between overly broad scales, which may obscure significant areas of impact in specific regions or sub-regions, and excessively fine scales, which could complicate the assessment process. This methodology was applied at the IMAP CIs 13 and 14 level for TP, DIN, and Chlorophyll-a as mandatory parameters. Other parameters were excluded due to the lack of data reported by the Contracting Parties. The 4-level nesting approaches were implemented in the Adriatic Sea Sub-region. This resulted in the aggregation and integration of assessment results within the IMAP nested scheme at the following levels:

1. IMAP national Spatial Assessment Units (SAUs) and sub-SAUs (the finest level)
2. IMAP coastal and offshore assessment zones of sub-divisions
3. Sub-division and sub-regional levels (e.g., Adriatic Sea).

For setting the IMAP assessment areas for CIs 13 and 14, the finest areas defined for CI 17 were adjusted to serve the purpose of eutrophication assessment. Additionally, a GIS layer was created to show the distribution of water classes within the coastal and offshore zones.

The scope of all SAUs and sub-SAUs was defined and introduced into the NEAT tool, along with their respective codes and surface areas (in km²). Within each SAU, under ‘habitats,’ the water types are introduced, and under ‘ecosystem component,’ the three measured parameters (DIN, TP, and Chlorophyll-a) are assigned.

Data elaboration was carried out for the surface layer, as it represents the primary layer of eutrophication impact. Freshwater inputs are the main pressure drivers and largely contribute to the stratification of the water column, confining newly introduced nutrients to the surface layer. For the application of the NEAT software, data were grouped by parameter, ecosystem, and SAU. Average concentrations (geometric means), along with the geometric standard deviation and standard error

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of the geometric means, were calculated for the respective groups. While arithmetic means and standard errors were used for CI 17, geometric means and standard errors were applied for CIs 13 and 14.

Boundary limits and class threshold values per SAU, parameter, and matrix are applied according to the assessment scale presented in the section on targets. The aggregation of TP, DIN, and Chlorophyll-a was carried out to derive a single status value (NEAT value) for all levels of the nesting scheme. The aggregation of the assessment results for these three parameters resulted in a NEAT value per specific SAU, which was then spatially integrated into the sub-divisions and regional levels. The assessment results were presented and visualized using a tabular format and graphical representations generated with a GIS tool.

For sub-regions and sub-divisions where, insufficient data was reported for applying the NEAT GES assessment methodology across nested assessment areas, three alternative methodologies were developed for eutrophication assessment:

1. **Ecological Quality Ratio (EQR) methodology**
2. **Simplified EQR methodology**
3. **Simplified Good/Moderate (G/M) comparison methodology.**

The EQR methodology was found relevant for assessing IMAP Common Indicators 13 & 14, where a full set of assessment criteria for Chlorophyll-a (Chla), Dissolved Inorganic Nitrogen (DIN), and Total Phosphorus (TP) exists. EQR is a dimensionless measure that compares the observed value of a measured parameter against reference conditions. The ratio ranges from 0 (large deviation) to 1 (equal to or better than reference conditions). EQR must be calculated for each boundary value, and a typology-based assessment must be conducted. However, due to the lack of data reported by Contracting Parties, this methodology could not be applied in the preparation of the 2023 Mediterranean Quality Status Report (MED QSR).

The Simplified EQR methodology was deemed relevant when complementary data (in situ and remote sensing) was available for Chla only, but typology-based assessment could not be applied. However, due to the lack of homogeneous, quality-assured data reported by CPs—even for Chla alone—this methodology could not be applied to any sub-region or sub-division in the 2023 MED QSR, except for the Tyrrhenian Sea. Thresholds must be defined to determine the boundary between Good Environmental Status (GES) and non-GES.

The Simplified G/M comparison methodology was used as an alternative to the NEAT GES Assessment, EQR, and Simplified EQR methodologies, relying solely on Chl-a data from remote sensing sources in cases where a typology-based assessment was not feasible. Data were aggregated as a 5-year geometric mean and normalized to ensure comparability across assessment areas. Normalization was conducted using the bestNormalize package in R. Each observation point or area was classified as GES or non-GES based on the assessment scale outlined in the Targets section.

Further details are provided in the thematic eutrophication assessments and the 2023 MED QSR Pollution Assessment.

Known gaps and uncertainties in the Mediterranean

Further to the significant progress achieved over the last few biennia regarding the standardizing monitoring practices and establishing Good Environmental Status (GES) and environmental assessment tools—along with the improved availability of assessment criteria – it is essential—, for a complete assessment of eutrophication and the achievement of GES, to define GES thresholds and

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reference conditions (natural background concentrations) not only for chlorophyll *a*, but also for total phosphorus (TP) and dissolved inorganic nitrogen (DIN) across all sub-regions. This should build on the relevant experience gained in setting reference and boundary values for these nutrients in the Adriatic Sea Sub-region,as minimum requirements. This process should include quality assurance schemes, as well as data quality control protocols.

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By building on the achievements up to 2023, during the preparation of the 2023 MED QSR, several knowledge gaps were identified in the monitoring and assessment of Common Indicators 13 and 14, which need to be addressed following the recommendations of the 2023 MED POL Focal Points Meeting.

Improve the availability of the assessment criteria for CIs 13 and 14:

Upon setting the reference conditions and boundary values for DIN and TP in the Adriatic Sea Sub-region, actions need to be undertaken to improve the availability of the assessment criteria for nutrients in the AEL, the CEN and the WMS Sub-regions. To that purpose the three continuous years of monitoring need to be provided 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. Further update of the assessment criteria for CI 14 should be undertaken as appropriate. The specific knowledge needs to be also built regarding the use of statistical tools for data validation and calculation of the assessment criteria.

Improve the GES assessment:

Further to the above elaborated common measures, the GES assessment for CIs 13 & 14 needs to be also improved, including the use of the remote sensing and modelling tools to complement *in situ* monitoring and adding additional sub-indicator i.e., the satellite-derived Chl*a* data for GES assessment.

Upgrade present policy measures:

For the development of the adaptive eutrophication management strategies, the following specific actions should also be undertaken:

- Extend the scope of research and monitoring programs to characterize the effects of eutrophication;
- Implement regulations to mitigate inputs of nutrient to the marine environment, such as standards, technology requirements, or pollution caps for various sectors.
- Preserve and restore natural ecosystems that capture and cycle nutrients.

Contacts and Version Date

http://www.unepmap.org

Version No	Date	Author
V.1	31.5.17	MEDPOL
V.2	10.1.19	MEDPOL
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V4	28/05/2025	Joint CorMon Pollution and ML Meeting

Indicator Title	Common Indicator 14. Chlorophyll *a* concentration in water column (EO5)	
V5		Approved by the Meeting of MED POL FPs
Final version		Approved by the 12th Meeting of EcAp Coordination Group

3. Guidance Factsheet on IMAP Common Indicators 17, 18, 20 and 21

8. The revision of IMAP **Common Indicator 17 (EO9)**: “Concentration of key harmful contaminants measured in the relevant matrix” is presented in the table bellow.

Indicator Title	Common Indicator 17. Concentration of key harmful contaminants measured in the relevant matrix (EO9)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**[12]
Level of pollution isbelow a determined threshold defined for the area and species	Concentration of priority contaminants is kept within acceptable limits and does not increase	State: • Concentrations of specific contaminants below either the boundary limit between GES and non-GES classes of the assessment scales or below reference concentrations (from other sources). • No ~~[~~increasing~~]~~ trends in contaminants concentrations in sediment and biota from human impacted areas, statistically defined. Pressure: • Reduction of contaminants emissions from land-based sources.
Rational		
Justification for indicator selection Chemicals are everywhere in our daily life and play a fundamental role in most of our activities, as they form part of virtually every device, we use to ensure our well-being, protect our health and security, and meet new challenges through innovation. Chemicals are also the building blocks of low-carbon, zero pollution and energy- and resource-efficient technologies, materials and products. The increased investment and innovative capacity of the chemicals industry to provide safe and sustainable chemicals will be vital to offer new solutions and support both the green and the digital transitions of our economy and society. [13]		

[12] Following the decisions to be made at the present meeting regarding minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3, the revised Targets will be incorporated into the revised IMAP Pollution Indicators Factsheets.
[13] Chemicals Strategy for Sustainability Towards a Toxic-Free Environment, European Commission, COM(2020) 667 final

Indicator Title	Common Indicator 17. Concentration of key harmful contaminants measured in the relevant matrix (EO9)

Environmental chemical pollution is directly linked with humankind activities in all the earth's ecosystems. Marine environmental investigations have detected thousands of man-made chemicals (both inorganic and organic compounds) all over the world oceans, which have been shown to impair the health of the marine ecosystems and their ecosystem services. The study of the occurrence, transport, transformation and fate, through the different ecosystem compartments (seawater column, marine biota, sediment, etc.), as well as the study of their sources and entry routes (land-based, sea-based (marine) and atmospheric wet and dry deposition) are the first steps to assess the pressures, state and impact to the environment understand and to decide further management actions fora growing environmental problem. Currently, new man-made chemicals and emerging pollutants continue to enter the marine environment and interact with the different marine species, habitats and ecosystems (coastal, open ocean, deep-sea areas), increasing the complexity of the chemical pollution threats for the marine environment and their future sustainability to deliver its benefits. The monitoring and assessment of the harmful and noxious substances occurrence, at selected spatial and temporal scales, will determine either a chronic or acute contamination/pollution scenarios.

Hazardous chemicals and their complex interaction with other environmental stressors can have long-term and large-scale environmental impacts on the terrestrial and marine environment. They can contribute to the reduction of ecosystem resilience, leading to rapid declines in animal populations and, ultimately, to extinctions, as well as impacting human health and wellbeing, not least through the possible presence of contaminants in the food chain. It is estimated that 2.8 million potentially contaminated sites exist in the EU, mainly from waste disposal and treatment, posing a significant environmental hazard for terrestrial and aquatic ecosystems and affecting the productivity of soils. The current regulatory and policy framework struggles to take this into account and needs to be strengthened.[14]

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[14] Chemicals Strategy for Sustainability Towards a Toxic-Free Environment, European Commission, COM(2020) 667 final

Indicator Title	Common Indicator 17. Concentration of key harmful contaminants measured in the relevant matrix (EO9)

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Indicator Title	Common Indicator 17. Concentration of key harmful contaminants measured in the relevant matrix (EO9)

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Policy Context and Targets

Policy context description

In most Mediterranean countries, the monitoring of a range of hazardous chemical substances in different marine compartments are undertaken in response to the UNEP/MAP Barcelona Convention (1976) and its Land-Based Protocol, through the coordination of the UNEP/MAP MED POL Monitoring Program. For Mediterranean EU Countries, the European legislation on the Marine Environment also applies (e.g. EU WFD and EU MSFD), as well as other international and national policy drivers. A considerable amount of founding knowledge and actions are available through the pollution monitoring and assessment component of the UNEP/MAP MED POL Programme during the past decades until today. The environmental assessments have been used for the identification and confirmation of significant marine contaminants occurrence, distributions, levels and trends; as well as, for the continuous development of monitoring strategies and guidance. With respect to the Ecosystem Approach and IMAP, their implementation continue under the benefits gained from this past knowledge and the policy and practical framework built in the Mediterranean Sea.

In the context of the Mediterranean Sea, the monitoring and assessment of contaminants were redefined in accordance with the Integrated Monitoring and Assessment Programme (UNEP/MAP, 2016). This redefinition also ensures synergy with the European Marine Strategy Framework Directive (200/56/EC). The Data Dictionaries and Standards for IMAP Common Indicator 17 (2019, http://imapinfosystem.info-rac.org/app/#/standard), aligned with the IMAP Guidance Factsheets, defined the list of mandatory datasets, including physico-chemical parameters, to provide an integrated assessment of contaminants in the Mediterranean.

Targets

As part of the preparation for the 2023 MED QSR pollution assessment, the following two assessment scales have been established and applied in the Mediterranean sub-regions to assess the Good Environmental Status, as applicable:

a) *The Scale of NEAT (Nested Environmental Status Assessment Tool) Integrated Assessment of Contaminants in Sediments and Biota Matrices (IMAP Common Indicator 17)*

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- The five-class assessment scale was applied to the data reported by countries for mandatory heavy metals and organic contaminants, enabling their use in calculating assessment criteria for the sub-divisions of the Adriatic Sea and Western Mediterranean sub-regions.
- The five-classes of assessment —High, Good, Moderate, Poor, and Bad—is established, with two boundary limit values that define the assessment scale: i) zero contaminant concentration representing the best conditions (High), and ii) the maximum contaminant concentration representing the worst conditions (Bad). Additionally, one threshold value for the GES / non-GES boundary is defined.
- The decision rule for GES/non-GES status is based on comparing score values against the boundary limit defined by the (xBAC) threshold, which distinguishes between the Good and Moderate classes. For trace elements, the threshold is set at 1.5 BACs, while for organic contaminants, the threshold is set at 2 BACs.
- NEAT values range from 0 to 1 and represent the overall status assessment for each contaminant, or the integrated assessment of multiple contaminants, based on the five-class scale. Average concentrations are calculated using arithmetic means, along with their respective standard errors. Threshold concentrations are normalized to a scale from 0 to 1 as follows:

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

- The status of class is determined by the linear distance of score values from the two boundary limits i.e. the zero-contaminant concentration and the maximum contaminant concentration, and the GES/non-GES threshold. GES status is assigned for values below 0.6, while non-GES status applies to values above 0.6.

NEAT Integrated Assessment of CI 17	**GES**		**non-GEs**			
	High	Good	Moderate	Poor	Bad	
Boundary limits	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤GES/nGES threshold	GES/nGES<meas. conc. ≤ moderate/poor threshold	moderate/poor threshold <mean. conc. ≤ max. conc.		
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.**
Thresholds	**BAC**	**(xBAC)**	**2 (xBAC) ∞**	**5 (xBAC) ∞**		

b) *The Scale of CHASE+ (Chemical Status Assessment Tool) for Contaminants in Sediments and Biota Matrices (IMAP Common Indicator 17)*

- The five-class assessment scale was used to evaluate contamination levels scale. It was applied to the data reported by countries for mandatory heavy metals and organic contaminants, enabling their use in calculating assessment criteria for the sub-divisions of the Aegean – Ionian and the Central Mediterranean sub-regions
- The five-class assessment: Non-Problem Area - High, Non-Problem Area - Good, Problem Area - Moderate, Problem Area - Poor, and Problem Area (PA) – Bad, is established with the two boundary limit values: i) zero contaminant concentration, representing the best conditions (High), and ii) maximum contaminant concentration, representing the worst conditions (Bad). Additionally, a threshold value is set to distinguish between Good Environmental Status (GES) and non-GES conditions.
- The decision rule for determining GES/non-GES status is based on comparing CHASE+ score values against the threshold (xBAC), which distinguishes the Good and Moderate classes. For trace elements, the GES/non-GES threshold is 1.5 BACs. For organic contaminants, the GES/non-GES threshold is 2 BACs.

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- The Moderate/Poor boundary is set at 2 × BAC, and the Poor/Bad boundary is set at 5 × BAC.
- CHASE+ values range from 0 to 5 and above, representing the overall contamination status of a station or area based on the Contamination Ratio (CR) or Contamination Score (CS).
- The GES/non-GES boundary is set at a CHASE+ score of 1, meaning only values equal to or below (x BAC) set as the GES/non GES threshold are considered GES. This classification aligns CHASE+ with the NEAT assessment methodology.
- Contamination Ratio (CR) is calculated as the ratio C_measured / C_threshold for each contaminant measured in a specific matrix (biota or sediment).
- Contamination Score (CS) is the simple average of CR values, providing an aggregated assessment of contaminants per matrix and station.
- The decision rule states that a station is considered GES if at least 75% of the elements assessed are within GES limits. The same rule applies when assessing area.

CHASE+ Assessment of CI 17	GES		non-GEs		
	High	Good	Moderate	Poor	Bad
Boundary Limits	0< meas. conc. ≤ BAC	BAC<meas. conc. ≤GES/nGES threshold	GES/nGES<meas. conc. ≤ moderate/poor threshold	moderate/poor threshold <mean. conc. ≤ max. conc.	
CHASE+ scores	0 <CR,CS ≤0.5	0.5<CR,CS≤ 1	1<CR,CS ≤ 2	2< CR,CS ≤5	CR,CS> 5
Thresholds	**½ (xBAC)**	**(xBAC)**	**2 (xBAC) ∞**	**5 (xBAC) ∞**	

Policy documents

General Policy documents

Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9).

Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28).

Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027.

Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.

Decision IG.24/4 (COP21, 2019) on Assessment Studies.

Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.

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UNEP/MAP WG.509/24 (2021). Monitoring Guidelines/Protocols for Sample Preparation and Analysis of Marine Biota for IMAP Common Indicator 17: Heavy and Trace Elements and Organic Contaminants. Meeting of the MED POL Focal Points, Videoconference, 6-7 October 2021.

UNEP/MAP WG.509/25 (2021). Monitoring Guidelines/Protocols for Sampling and Sample Preservation of Seawater for IMAP Common Indicator 17: Heavy and Trace Elements and Organic Contaminants. Meeting of the MED POL Focal Points, Videoconference, 6-7 October 2021.

UNEP/MAP WG.509/26 (2021). Monitoring Guidelines/Protocols for Sample Preparation and Analysis of Seawater for IMAP Common Indicator 17: Heavy and Trace Elements and Organic Contaminants. Meeting of the MED POL Focal Points, Videoconference, 6-7 October 2021.

UNEP/MAP WG.492/10/ Rev.2 (2021). Integration and Aggregation Rules for Monitoring and Assessment of (IMAP Pollution and Marine Litter Cluster). Meeting of the Ecosystem Approach Correspondence Group on Pollution Monitoring, Videoconference, 26-28 April 2021.

UNEP/MAP WG. 533/Inf.3 (2022). Adjusted Background (Assessment) Concentrations (BC/BAC)

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for Common Indicator 17 and Upgraded Approach for Environmental Assessment Criteria (EAC) for IMAP Common Indicators 17, 18 and 20	
Indicator analysis methods	

Indicator Definition

Concentrations of key contaminants in the following matrices (note this is a multiparameter pressure indicator):

MARINE BIOTA: In collected marine organisms, where whole soft tissues or dissected parts, following the analytical procedure detailed in the Monitoring Guidelines for CI 17, are processed according sampling and sample preparation protocols, and primarily, in bivalve species and/or fish the following hazardous substances should be measured as mandatory, as agreed upon at the 2017 Meeting of MED POL Focal Points and further elaborated during the preparation of Data Standards for CI 17

- Trace/Heavy Metals (TM): Mercury and its compounds (Hg), Cadmium and its compounds(Cd), Lead and its compounds (Pb), and Copper and its compounds;Organochlorinated compounds: PCB congeners: 28, 52, 101, 118, 138, 153, 180, 105 and 156; Σ 7PCBs (28, 52, 101, 118, 138, 153, 180); Hexachlorobenzene, Gamma-HCH Lindane and ΣDDTs (DDT, p,p' + DDT, o,p' + DDE, p,p' + DDD, p,p');
- 16 Polycyclic Aromatic Hydrocarbons (PAHs): Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz[a,h]anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene, along with total Σ16 PAHs;

The lipid content and flesh fresh/dry weight ratio should be measured in biota for normalisation and reporting purposes.

MARINE SEDIMENTS: In coastal and marine areas, continental platform and offshore, sediments should be collected by mechanical means and processed at the laboratory (< 2 mm particle size fraction), following the analytical procedure detailed in the Monitoring Guidelines for CI 17 Further the following hazardous substances should be measured as mandatory, as agreed upon at the 2017 Meeting of MED POL Focal Points and further elaborated during the preparation of Data Standards for CI 17

- Trace/Heavy Metals (TM): Mercury and its compounds (Hg), Cadmium and its compounds(Cd), Lead and its compounds (Pb), and Copper and its compounds;Organochlorinated compounds; PCB congeners: 28, 52, 101, 118, 138, 153, 180, 105 and 156); Σ 7PCBs (28, 52, 101, 118, 138, 153, 180);, aldrin; dieldrin; Hexachlorobenzene; Gamma-HCH Lindane and ΣDDTs (DDT, p,p' + DDT, o,p' + DDE, p,p' + DDD, p,p');
- 16 Polycyclic Aromatic Hydrocarbons (PAHs): Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz[a,h]anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene, along with total Σ16 PAHs;

Following the analytical procedure detailed in the Monitoring Guidelines for CI 17, the aluminium (Al), Total Organic Carbon (TOC) in the < 2mm particle size fraction should be performed for normalization and reporting purposes for TM and OCs, respectively. The < 63µm sediment fraction is also recommended to be complementary for metals.

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The liophilization ratio (dry/wet sediment ratio) should be considered for datasets reporting.

SEAWATER: the monitoring and assessment of contaminants in seawater samples collected in coastal, marine and open-sea areas presents specific challenges and higher costs. For the mid/long-term monitoring programmes, such as IMAP, these are recommended to be carried out on a country decision basis. The analytical procedure is detailed in the Monitoring Guidelines for CI 17,

Sub-indicators: other relevant mandatory chemicals are elaborated in Data Standards for IMAP CI 17, whereby emerging pollutants are recommended to be monitored based on the availability of relevant scientific knowledge and research, and accordingly proposed for decision making by the Contracting Parties. Data Standards for CI 17 include the reporting of a long list of non-mandatory parameters concerning the decision of the national IMAP competent authorities.

Methodology for indicator calculation

Trace/Heavy Metals (TM) and Aluminium: Spectrometry, Mass Spectrometry

Organic compounds: Gas or Liquid Chromatography (GC/LC) coupled to a variety of detectors, such as Electron Capture Detectors or Mass Spectrometry, atomic adsorption.

The list of all chemical and related parameters subject to reporting for IMAP CI 17 by the Contracting Parties is elaborated in the Data Standards for IMAP CI 17.

The detailed analytical procedure for the above chemicals and other related mandatory parameters, including sampling and sample transportation, analytical determination of indicators and sub-indicators, data quality control are outlined in:

- B-1. Monitoring Guidelines/Protocols for sampling and analysis of contaminants in sediment.
- B-2. Monitoring Guidelines/Protocols for sampling and determination of contaminants in marine biota.
- B-3. Monitoring Guidelines/Protocols for sampling and analysis of contaminants in seawater.

Indicator units

Trace/Heavy Metals (TM) and Aluminium: mass/dry or wet weight mass of sample according to Data Standards for CI 17. The dry/wet mass ratios should be calculated and reported.

Organic compounds (OCs): mass/dry or wet weight mass of sample according according to Data Standards for CI 17.. The dry/wet mass ratios should be calculated and reported.

Data Standards for IMAP CI 17 elaborates units for other relevant mandatory chemicals and parameters.

List of Guidance documents and protocols available

IMAP Monitoring Guidelines/Protocols (https://www.iaea.org/about/organizational-structure/department-of-nuclear-sciences-and-applications/division-of-iaea-environment-

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laboratories/marine-environmental-studies-laboratory/unep-map-med-pol-integrated-monitoring-and-assessment-programme-imap-monitoring-guidelines)

- B-1. Monitoring Guidelines/Protocols for sampling and analysis of contaminants in sediment.
- B-2. Monitoring Guidelines/Protocols for sampling and determination of contaminants in marine biota.
- B-3. Monitoring Guidelines/Protocols for sampling and analysis of contaminants in seawater.
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20

Data Confidence and uncertainties

The implementation of IMAP provided scientific evidence of significant variations between the four Mediterranean sub-regions, therefore values of BCs/BACs at the sub-regional level were initially introduced in 2019 and furthermore elaborated in the period in the period 2020-2022. The frequency of analyzing one sample of either biota or sediment within proficiency testing organized in collaboration of UNEP/MAP-MEDPOL and IAEA-MESL is insufficient for calculation of the precision of monitoring data. Therefore, the further update of the regional and sub-regional BCs/BACs values for the Mediterranean was completed in 2022 using new data sets reported by the countries, and by applying certain adjustments to the methodology already used in 2016 and 2019 (UNEP/MED WG365/Inf.8 (2011); UNEP/MED WG.533/Inf.3; UNEP/MED WG.533/3).

Selected analytical methods and measurements are subject to internal Quality Assurance through National Laboratories QA/QC Protocols and Laboratory accreditations, as well as external Quality Assurance by performing regional interlaboratory QA/QC exercises organized in collaboration of the UNEP/MAP - MED POL and the IAEA/MESL since 1986. .

Uncertainties in marine data measurements are identified at different levels (cumulative): analytical level (by use of Certified Reference Materials), reporting level (by providing averaged values and the associated uncertainties), database flagging level (primarily according the analytical and reporting compliance, number of non-detected values and levels, fulfilment of the QA/QC Protocols and Interlaboratory Exercises).

Up to 2023, the IAEA/MESL, in collaboration with the UNEP/MAP - MED POL, implemented 56 interlaboratory comparisons/proficiency tests for the analysis of trace elements and organic contaminants, as well as 64 training courses on the analysis of trace elements and organic contaminants in marine samples. Over 370 analytical laboratory practitioners have been trained at MESL. As of 2018, the scope of proficiency testing and training courses has been adjusted to meet the needs of Mediterranean laboratories in implementing monitoring programmes for trace elements (covering mandatory heavy metals – Cd, Hg, Pb, Cu in line with IMAP requirements, as well as additional elements such as Al, As, Co, Cr, Fe, Li, Mn, Ni, and Zn) and organic contaminants for IMAP Common Indicator 17 (covering mandatory organic contaminants including organochlorine (OC) pesticides, polychlorinated biphenyl congeners (PCBs), and polycyclic aromatic hydrocarbons (PAHs), also in accordance with IMAP requirements). Designated national laboratories participating in the proficiency tests receive, along with the sample, clear instructions on how to proceed with the PT sample and how to report the results. They are requested to use established analytical methods and are recommended to apply quality control and laboratory quality assurance procedures. The results of analyses of a matrix-matching quality control (QC) sample must be reported along with the results from the PT sample.

As of 2024, the scope of proficiency testing and training courses has been expanded to support the capacities of national laboratories in monitoring eutrophication (IMAP Common Indicators 13 &

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14: inorganic nutrients in high salinity seawater, in estuarine and low salinity seawater, and chlorophyll a and Phaeopigments in Seawater) and contaminants in seafood (IMAP Common Indicator 20: heavy metals including the mandatory heavy metals – Cd, Hg, Pb, Cu, as well as additional elements such as Al, As, Co, Cr, Fe, Li, Mn, Ni, and Zn as specified for CI 17, polycyclic aromatic hydrocarbons (PAHs), dioxins, and PCBs). In addition, the data quality control range categories were initially established for physic-chemical parameters related to the monitoring of IMAP Common Indicators 13 and 14, as well as for contaminants related to the monitoring of Common Indicator 17, by applying relevant statistical methods and available scientific expertise in ensuring the quality of data reported to the IMAP Info System. These data control categories have been integrated into the IMAP Info System as of 2024.	
Methodology for monitoring, temporal and spatial scope	
Available Methodologies for Monitoring and Monitoring Protocols In line with the Ecosystem Approach and the IMAP implementation, there are considerable benefits to be gained from taking advantage of previous knowledge and information developed through the UNEP/MAP-MED POL. These actions include (1) the use of existing experience in the design of monitoring programmes, (2) the use of existing guidance on sampling and analytical methods to inform technical aspects of ecosystem approach monitoring, (3) the use of existing sampling station networks as a framework for the ecosystem approach monitoring networks, (4) the use of existing statistical assessment tools and work on assessment criteria as the basis for the assessments of ecosystem approach data, (5) the use of existing data to describe the distributions and levels of contaminants against EACs and reference concentrations, and (6) the use of existing time series as the basis of monitoring against a "no deterioration" target. The availability of quality assured data is of importance for the assessment of trends and levels and their comparability overtime and across spatial scales. Building on elements elaborated in the Integrated Monitoring and Assessment Programme (2016 IMAP), including the above-mentioned components, the Monitoring Guidelines—structured around the specific technical protocols related to IMAP Common Indicator 17 —were comprehensively developed by the MED POL Programme in cooperation with IAEA/MESL. These guidelines were approved by the MED POL Focal Points Meeting (2021).They build upon the knowledge and practices obtained over 40 years of MED POL monitoring implementation and recent publications, highlighting the current practices of the Contracting Parties' marine laboratories, as well as other Regional Seas Conventions and the EU. A thorough analysis of presently available practices of UNEP/MAP, UNEP and IAEA, as well the HELCOM, OSPAR and European Commission Joint Research Centre was undertaken to assist an innovative approach for preparation of the IMAP Monitoring Guidelines/Protocols. The monitoring methodologies and practices are elaborated for sampling, sample preservation and transportation, sample preparation and analysis, along with quality assurance and reporting of monitoring data, for their use by the IMAP competent laboratories in order to ensure the representativeness and accuracy of the analytical results. These guidelines present a summary of the best available known practices employed in marine monitoring by bringing integrated comprehensive analytical practices that can be applied in order to ensure the representativeness and accuracy of the analytical results needed for generation of quality assured monitoring data. The Monitoring Guidelines for IMAP Common Indicator 17 outline the following monitoring and reporting practices: o B-1. Monitoring Guidelines/Protocols for sampling and analysis of contaminants in sediment; o B-2. Monitoring Guidelines/Protocols for sampling and determination of contaminants in marine biota;	

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- B-3. Monitoring Guidelines/Protocols for sampling and analysis of contaminants in seawater;
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.

Available data sources

i. IMAP Info System (http://imapinfosystem.info-rac.org/app/#/)
ii. EMODNET Chemistry: http://www.emodnet-chemistry.eu/data_access.html

Additional potential data sources:

- The scientific literature providing data on no effect or adverse biological effects alongside chemical data from the environment and biota at the same site and time.
- The studies providing sediment toxicity tests, aquatic toxicity tests in conjunction with equilibrium partitioning (EqP), and field and mesocosm studies from relevant scientific sources in consultation with the national counterparts. The selected studies should include all relevant auxiliary information: citation, type of test, type of biological effect, analytical approach used, study area, test duration, species tested or the benthic community considered, TOC, Acid volatile sulphide (AVS), chemical concentrations, among others.

Spatial scope guidance and selection of monitoring stations

The spatial scope for monitoring should include reference and coastal long-term master stations, including offshore, distributed spatially as relevant and include local spatial refinements, such as transect sampling (for sediment and/or active biomonitoring); and therefore, is a direct function of the risk-based assessments and the long-term monitoring purposes. The selection of the sampling sites for the monitoring of contaminants in the marine environment should consider:

- Risk areas of concern identified on the basis of the review of the existing information.
- Vulnerable areas of known past and/or present release of chemical contaminants.
- Offshore areas where risk warrants coverage (aquaculture, offshore oil and gas activity, dredging, mining, dumping at sea and others).
- Monitoring sites representative of other sources, such as shipping and atmospheric inputs.
- Reference monitoring sites: to establish scale-based reference values and background concentrations.
- Monitoring sites representing sensitive pollution sites/areas at national and sub regional scale.
- Monitoring sites in deep-sea sites, offshore stations (sediments) and areas of potential particular concern.

The selected sites should allow the collection of a realistic number of samples over the years (e.g. to be suitable for sediment sampling, to allow sampling a sufficient number of biota for the selected species during the duration of the programme). It is essential that the monitoring strategies are being coordinated at regional and/or sub regional level. The coordination with the monitoring networks for other Ecological Objectives is crucial for cost-effective and future IMAP integrated assessment.

As part of the 2023 MED QSR preparation, the assessment scales for CI 17 are defined within the framework of the IMAP nested approach, applying, among others, the above-listed criteria for the selection of the sampling sites, and building upon the elements outlined in the section on Assessment of Eutrophication.

Temporal Scope guidance

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Sampling frequencies will be determined according the current status of the national marine monitoring.

INITIAL PHASE OF IMAP MONITORING: to identify key sampling sites/stations within a coastal network which should include: BIOTA samples (bivalves, e.g. *Mytilus galloprovincialis,* as commonly agreed, mandatory IMAP species where present in local ecosystems, *Donax trunculus*, etc.), yearly collection, and fish (i.e. *Mullus barbatus,* as commonly agreed, mandatory IMAP species where present in local ecosystems) every 4 years. In this phase monitoring SEDIMENTS (coastal, offshore areas) should be collected every two years.

ADVANCED PHASE OF IMAP MONITORING (when there is a fully completed IMAP Initial Phase of implementation with the ongoing data reporting) should include: BIOTA from 1 to 3 years according the trends and levels of chemicals assessed at the different stations/sites, and SEDIMENTS from 3 to 6 years depending on the characteristics of sedimentation areas and the chemical concerned known through previous assessments.

The temporal scope may range from seasonally variable parameters up to large time scales, e.g. sediment core monitoring (years to decades). For temporal trend determinations the sampling frequencies will depend on the ability to detect trends considering the environmental and the analytical variability (ca. total uncertainty). It can be possible to decrease the sampling frequencies and target chemicals in cases where established time trends and levels show concentrations well below levels of concern, and without any upward trend over a number of years (including the stations/sites where recurrently exhibit non-detected contaminants value; that is below detection and quantification limits).

Data analysis and assessment outputs

Statistical analysis and basis for aggregation – Assessment Criteria

Monitoring should allow the necessary statistical data treatments and long-term time-trend data analysis.

Deriving and setting up the assessment 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) substances 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).4F[15]

The calculation of BC values is the first step for 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. The BCs for CI 17 were derived using the following two methodologies: i) data from sediment cores compiled from the scientific literature (UNEP/MAP 2011),5F[16] and ii) data from the MED POL database (UNEP/MAP 2011, 2016, 2019). A complete explanation of the used methodologies, including the specific methodologies used by UNEP/MAP for the different parameters, is given in previous UNEP/MAP documents (UNEP/MAP 2011, 2016,

[15]Additional definitions for BC can be found in the literature and are explained in UNEP/MED WG.533/Inf.3

[16]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.

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2019), as well as in UNEP/MED WG.533/10, Annex III, Appendix 1 and UNEP/MED WG.533/Inf.3.

BAC values 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 the calculation of BAC values from BC concentrations, UNEP/MAP adopted the methodology that corresponds to the OSPAR methodology.6F[17] 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. Detailed elaboration is provided in UNEP/MED WG.533/10, Annex III, Appendix 1 and UNEP/MED WG.533/Inf.3.

The MedBAC values endorsed in Decisions IG.22/7 and IG.23/6 were as follows: MedBAC for TM in sediments, mussel and fish (Tables 1 and 3 of UNEP/MED WG.533/10, Annex III, Appendix 1), PAHs in sediments and mussel (Tables 2 and 4 of UNEP/MED WG.533/10, Annex III, Appendix 1). In 2019, the same methodology was used to propose the derivation of specific sub-regional MedBAC values. Further to work undertaken in 2019, the regional and sub-regional BAC values were updated in 2022, using the same methodology applied for the previous update.

The new data critically analyzed (UNEP/MED WG.533/10, Annex III, Appendix 1 and UNEP/MED WG.533/Inf.3) were used to update the BC and BAC values for the sub-regions of the Mediterranean and for the whole Mediterranean Sea, ~~as provided in Tables 4 to 8,~~ by using the same methodology as initially applied in 2016/2017 and replicated in 2019.[18]

BAC values for trace metals were calculated by multiplying the BCs by a factor as follows: i) MedBAC=1.5 x MedBC (for mussel and sediments matrices); ii) MedBAC=2.0 x MedBC (fish).

For Polycyclic Aromatic Hydrocarbons (PAHs) in sediments and mussel (*M. galloprovincialis)*, BAC values were calculated as follows: MedBAC=1.5 x MedBC.[19]

When most of the data originated from one sub-region, or there were significant differences among the sub-regions, the BC values were calculated for sub-regions and not for the whole Mediterranean.

It was noted that in some instances there was a large variability (up to > 100%) on BACs values between the values re-calculated in 2017, 2019 and 2022. Therefore, it was recommended by the Meeting of CorMon (1-2 March 2023) that when deciding on the use of threshold for GES assessment, this variability should be taken into account for each sub-region.

The reporting of new data from CPs to the IMAP-IS allowed for the calculation of the new BC and BAC values for PAHs in the mussel (*M. galloprovincialis).* As for sediments, data with BDL values were used in the calculation of the new BCs. 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.[20] This could be the one reason for the differences in BACs between sub-regions.

[17] At present, no statistical assessment was possible for the precision of the monitoring data reported into IMAP Info system given the quantity of data reported, as well as a frequency of analyzing one sample of either biota or sediments 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 2017 and 2019. A detailed explanation is given in section 2.3.1 of the information document UNEP/MAP WG.533/Inf.3.
[18] 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).
[19] 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.
[20] See Annex III in UNEP/MAP WG.533/Inf 3.

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The Meeting of CorMon Pollution (1-2 March 2023) also agreed to add the concentration of the Sum of (16) PAHs to the list of parameters in addition to reporting the concentrations of individual 16 PAHs, given it was included in Data Dictionaries as the mandatory parameter for CI 17.

The reporting of new data from CPs to the IMAP-IS allowed for the calculation of BACs for organochlorinated contaminants (IMAP addresses PCBs and pesticides within organochlorinated contaminants) in sediments and *M. galloprovincialis*. The BACs used for organochlorinated contaminants are based on the detection limits of the methods used and their uncertainty (precision and accuracy), as determined from CRMs (Certified reference materials) and proficiency testing.

These new BC and BAC values for IMAP CI 17, as revised and approved by the Meeting of CorMon Pollution (27 and 30 May 2022) (UNEP/MED WG.533/10, Annex III, Appendix 1), and approved by Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean, are presented here-below in Tables 1 to 5.

Table 1. New updated BC and BAC values for trace metals in sediments calculated from data available for upgrade of the criteria, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022). The units of concentration are given in µg/kg dry wt, as requested by IMAP.

New updated BC and BAC values for trace metals in sediments					
New updated BC values (2022) in sediments, µg/kg dry wt					
TM	MED	WMS	ADR	CEN	AEL
Cd	107	140	120	#	78.9
Hg	50.0	90.0	50.0	#	31.5
Pb	15000	16000	15700	1805	15674
New updated BAC values (2022) in sediments, (µg/kg dry wt)					
	Med	WMS	ADR	CEN	AEL
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.*

Table 2. New updated BC and BAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments calculated from data available for upgrade of the criteria, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022). The units of concentration are given in µg/kg dry wt, as requested by IMAP.

New updated BC and BAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments					
	Updated BC values (2022) in sediments, µg/kg dry wt				
PAH compounds	MED	WMS	ADR	CEN	AEL
Naphthalene	2.00	8.0	2.0	#	2.3
Acenaphthylene	(1.0)#	#	#	0.4	#
Acenaphthene	(2.0)#	#	#	*	#
Fluorene	(2.0)#	#	#	0.4	#
Phenanthrene	3.10	14.9	3.5	0.8	3.1
Anthracene	(2.2)#	#	#	#	#
Fluoranthene	5.00	#	7.0	0.1	2.7
Pyrene	6.20	24.8	8.0	0.4	3.0
Benzo[a]anthracene	3.38	19.7	4.1	*	1.8
Chrysene	2.70	35.9	4.6	1.6	1.6
Benzo(b)fluoranthene	5.00	8.7	15.0	*	2.6
Benzo(k)fluoranthene	4.00	#	3.0	*	#
Benzo[a]pyrene	(4.0)#	#	4.0	#	1.0
Benzo[g,h,i]perylene	(4.2)#	#	5.7	*	1.8
Dibenz[a,h]anthracene	(1.0)#	7.0	#	*	#

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Indeno[1,2,3-c,d]pyrene	(4.0)#	#	4.4	*	2.1
Sum PAHs	27.4	160	41.0	6.3	21.4
	Updated BAC values (2022) in sediments, µg/kg dry wt				
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
Sum PAHs	41.0	240	61.5	9.5	32.0

*#most data (>50%) below detection limit, * no data reported*

Table 3. New updated BC and BAC values for trace metals in mussel (*M. galloprovincialis*) and fish (*M. barbatus*) calculated from data available for upgrade of the criteria, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022). The units of concentration are given as requested by IMAP.

New updated BC and BAC values for trace metals in mussel soft tissue (*M. galloprovincialis*), µg /kg dry wt					
New updated BC values (2022)					
TM	**MED**	**WMS**	**ADR**	**CEN**	**AEL**
Cd	710	1030	629	*	942>
Hg	77.9	85.0	75.4	*	110>
Pb	1100	1260	1000	*	2300>
New updated BAC values (2022)					
TM	**MED**	**WMS**	**ADR**	**CEN**	**AEL**
Cd	1065	1545	944	*	1413>
Hg	117	128	113	*	165>
Pb	1650	1890	1500	*	3450>

** Only a few data points were available for the CEN. The calculated BCs were lower than in other sub-regions, however, the few data are not representative of the CEN.*
> Since new data were not available in the AEL to update BC/BAC values for M. galloprovincialis, it was approved to use the values calculated in 2019.

New updated BC and BAC values for trace metals in fish muscle *(Mullus barbatus)*, µg/kg wet wt					
New updated BC values (2022)					
TM	**MED**	WMS	ADR	CEN	AEL
Cd	3.9	*	5.3	*	3.6

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Hg	40.6	*	120	*	33.7
Pb	18.3	*	40.8	*	13.5
New updated BAC values (2022)					
	MED	WMS	ADR	CEN	AEL
Cd	7.8	*	10.6	*	7.2
Hg	81.2	*	240	*	67.4
Pb	36.6	*	81.6	*	27.0

** Given the lack of data, it was not possible to propose values for BC in these sub-regions, therefore it was approved to use the regional MED BC values for the GES assessment*

Table 4. New BC and BAC values for Polycyclic Aromatic Hydrocarbons **(**PAHs) in mussel (*M. galloprovincialis)* calculated from data available for upgrade of the criteria, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022). The unit of concentration is given in µg/kg dry wt, as requested by IMAP. No data were available for the CEN and the AEL Sub-regions.

New BC and BAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in mussel (*M. galloprovincialis*), µg/kg dry wt			
New BC values (2022)			
	MED	WMS	ADR
Naphthalene	0.56	0.52	#
Acenaphthylene	(0.05)#	#	#
Acenaphthene	(0.50)#	#	#
Fluorene	2.50	7.87	#
Phenanthrene	5.35	19.9	2.25
Anthracene	1.12	0.94	#
Fluoranthene	4.83	10.0	#
Pyrene	2.50	5.54	#
Benzo[a]anthracene	0.60	0.69	#
Chrysene	2.54	2.98	#
Benzo(b)fluoranthene	1.00	1.36	#
Benzo(k)fluoranthene	1.00	0.73	#
Benzo[a]pyrene	(1.00)#	0.94	#
Benzo[g,h,i]perylene	1.00	0.67	#
Dibenz[a,h]anthracene	(0.10)#	#	#
Indeno[1,2,3-c,d]pyrene	(0.63)#	0.29	#
Sum 16 PAHs [21]	5.80	5.60	6.60
New 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	#
Fluoranthene	7.25	15.0	#
Pyrene	3.75	8.31	#
Benzo[a]anthracene	0.90	1.04	#
Chrysene	3.81	4.46	#

[21] Data dictionary gives 2 additional categories: Sum 4 PAHs Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene) and Sum 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.

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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	#
Sum 16 PAHs	8.70	8.40	9.90

#*most data (>50%) below detection limit;*

Table 5. New BAC values for organochlorinated contaminants (PCBs and pesticides) in sediments and mussel (*M. galloprovincialis*), calculated from data available for upgrade of the criteria, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022). The unit of soncentrations is given in µg/kg dry wt, as requested by IMAP. 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.

New BAC values (2022) for organochlorinated contaminants (PCBs and pesticides) in sediments and mussel (*M. galloprovincialis*)					
SEDIMENTS, µg/kg dry wt	MED	WMS	ADR	CEN	AEL
PCBs					
PCB28	0.10	#	#	#	0.09
PCB52	0.07	0.10	0.09	#	0.04
PCB101	0.10	0.16	0.16	*	#
PCB118	0.10	0.46	0.18	#	0.01
PCB138	0.11	0.26	0.24	#	#
PCB153	0.14	0.40	0.28	#	0.02
PCB180	0.09	0.13	0.13	#	#
Sum 7 PCBs	0.40	1.60	0.21	#	0.19
Pesticides					
γ-HCH (Lindane)	(0.1)#	#	#	*	0.02
DDE(p,p’)	(0.1)#	0.23	#	#	*
Hexachlorobenzene	(0.1)#	#	#	#	*
Dieldrin	(0)#		#	#	#
BIOTA – MG, µg/kg dry wt	MED	WMS	ADR	CEN	AEL
PCBs					
PCB28	0.20	0.07	1.38	*	*
PCB52	0.38	0.3	0.5	*	*
PCB101	1.20	1.1	1.4	*	*
PCB118	1.23	1.5	1.4	*	*
PCB138	2.31	2.4	3.3	*	*
PCB153	3.45	4.6	4.6	*	*
PCB180	0.50	0.3	0.5	*	*
Sum 7 PCBs	18.4	28.6	17.3	*	*
Pesticides					
γ-HCH (Lindane)	(1.0)#	#	#	*	*
DDE(p,p’)	3.05	3.05	*	*	*
Hexachlorobenzene	(0.5)#	#	#	*	*
Dieldrin	(1.0)#	#	*	*	*

*# most data (>50%) below detection limit. * no data reported*

EAC values are the concentrations above which significant adverse effects on the environment or 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. Given it was impossible to develop EACs specific for the Mediterranean, 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

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IG.23/6 are as follows: EAC values for TM, PAHs and organochlorinated contaminants (PCBs and pesticides) i.e., 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).

The EAC values for TM in biota as endorsed by Decisions IG.22/7 and IG.23/6 are the concentrations in fish and seafood recommended as dietary limits for human consumption concerning human health (EC), derived from the following EU Directives regulating maximum levels for certain contaminants in foodstuffs: EC/EU 1881/2006 and amendment 629/2008. EAC values for organic contaminants (PAHs and organochlorinated contaminants) in mussels were taken from OSPAR.[22]

It must be noted that the EAC values set up to protect human health may be too lenient to protect the Mediterranean Sea if the goal is to achieve and maintain GES where the contaminants cause no significant impact on coastal and marine ecosystems. However, EAC values for CI 17 cannot be updated based on existing monitoring data. It needs very specific in-depth research of the ecotoxicological and environmental scientific literature.

Therefore, the methodology detailed in the European Commission Guidance Document (2018) and in Long et al. (1995) was recommended by the Meeting of CorMon Pollution (27 and 30 May 2022) for an 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. 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.

Upgrade of the EAC values for the Mediterranean Sea is a long-term task that needs dedicated, very specific, scientific research (more detailed elaboration is provided in UNEP/MED WG.533/Inf 3). Meanwhile, the EAC values as endorsed for TM (Cd, Hg and Pb) and organic contaminants (PAHs, PCBs and pesticides) in Decisions IG.22/7 and IG.23/6 will continue to be applied in the Mediterranean. They are shown here-below in Tables 6 to 8.

Further to the gaps identified within the preparation of the IMAP Pollution Assessments of the 2023 MED QSR, it is necessary to further align the list of EAC values included in Decisions IG.23/6 and IG.22/7 with the sources originally used (i.e., Long et al., 1995, OSPAR, 2009. 23) The following slight updates are included in Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean:

a) Table 6: The new EAC values were added for the following PAHs: i) Naphthalene; Acenaphthylene; Acenaphthene Fluorene; Dibenz [a,h]anthracene and Sum16 PAHs in sediments and ii) Naphthalene in biota.
b) Table 7: The new EAC value is added for Sum 7 PCBs in sediments. The EAC value of 11.5 µg/kg dry wt in Decision IG 22/7 originated probably from Long et al. (1995) as explained in document UNEP/MED 427/Inf.3.[24] However, Long et al. (1995) presents the ERL value of 22.7 µg/kg dry wt for Total PCBs in sediments but do not specify which congeners were considered. Moreover, OSPAR has not adopted an EAC value for the sum

[22] OSPAR Commission, Agreement number 2009-2. Agreement on CEMP Assessment Criteria for the QSR 2010. Publication number 2009/461. CEMP: 2008/2009 Assessment of trends and concentrations of selected hazardous substances in sediments and biota. Publication number 2009/390. OSPAR QSR 2000-Chapter 4.
[23] Long, E., D. Macdonald, S. Smith and F. Calder (1995). "Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments." Environmental Management **19**(1): 81-97, OSPAR Commission, Agreement number 2009-2. Agreement on CEMP Assessment Criteria for the QSR 2010. Publication number 2009/461.
[24] Table A.3.1:" ERL for ICES sum of 7CB is total CB concentration/2"

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of 7 PCBs in sediments. Therefore, further to experience related to the preparation of the assessments within the 2023 MED QSR, the EAC value of 67,9 is included to present the sum of 7 individual IMAP PCB congeners.

Table 6. Mediterranean EAC values for trace metals in sediments and biota, as endorsed by Decision IG.23/6

Mediterranean EAC values for trace metals in sediments and biota			
TM	**MedEAC***	**#MedEAC**	**#MedEAC**
	Sediments, µg/kg dry wt	***M. galloprovincialis,* µg/kg dry wt**	***Mullus barbatus,* µg/kg wet wt**
	IG.23/6	IG.23/6	IG.23/6
Cd	1200	5000	50
Hg	150	2500&	1000
Pb	46700	7500	300

** Med EAC values equal to ERL (Effects Range Low, Long et al. 1995, idem OSPAR values). # Med EAC values equal to the maximum regulatory levels for contaminants in foodstuffs as provided in EC/EU 1881/2006 and 629/2008 Directives*
& Not included in EU directives, but adopted by OSPAR

Table 7. Mediterranean EAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments and biota, as endorsed by Decisions IG.23/6 and IG.22/7, along with a few updated values to ensure consistency with ERL Long et al., and OSPAR EAC values

Mediterranean EAC values for Polycyclic Aromatic Hydrocarbons (PAHs) in sediments and biota				
	Sediments, µg/kg dw		**Biota Mussels, µg/kg dw**	
PAH compounds	**EAC* IG.22/7 and IG.23/6 - OSPAR and ERLs**	**ERL Long et al, 1995#**	**EAC** IG.22/7 and IG.23/6 - OSPAR**	**OSPAR#**
Naphthalene		160		340
Acenaphthylene		44		
Acenaphthene		16		
Fluorene		19		
Phenanthrene	240		1700	
Anthracene	85		290	
Fluoranthene	600		110	
Pyrene	660		100	
Benzo[a]anthracene	261		80	
Chrysene	384			
Benzo(b)fluoranthene				
Benzo(k)fluoranthene			260	
Benzo[a]pyrene	430		600	
Benzo[g,h,i]perylene	85		110	
Dibenz [a,h]anthracene		63.4		

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Indeno[1,2,3-c,d]pyrene	240			
Sum 16 PAHs		4022		

** Med EAC values equal to ERL (Effects Range Low, Long et al. 1995, idem OSPAR values)*
*** Med EAC values equal to OSPAR values*
 # Med EAC values equal to ERL (Effects Range Low, Long et al., 1995) which were not included in Decisions IG.22/7 and IG.23/6.

Table 8. Mediterranean EAC values for for organochlorinated contaminants (PCBs and pesticides) in sediments and biota, as endorsed by Decisions IG.23/6 and IG.22/7 along with the one updated value

Mediterranean EAC values for for organochlorinated contaminants (PCBs and pesticides) in sediments and biota					
	Sediments			**Mussel**	**Fish**
PCBs	**EAC# IG.22/7 (µg/kg dry wt) – updated**	**EAC* IG.22/7 (µg/kg dry wt)**	**EAC** IG.23/6 (µg/kg dry wt)**	**EAC** IG.22/7 and IG.23/6 (µg/kg dry wt)**	**EAC** IG.22/7 and IG.23/6 (µg/kg lipid)**
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
Sum 7 PCBs	67,9				
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) or used by OSPAR (2009)*
*** From OSPAR (2009)*
#The EAC value of 11.5 µg/kg dry wt in Decision IG 22/7 originated probably from Long et al, 1995 as explained in document UNEP/MED 427/Inf.3. However, Long et al.,1995 present the ERL value of 22.7 µg/kg dry wt for Total PCBs in sediments but do not specify which congeners were considered. Moreover, OSPAR has not adopted an EAC value for the sum of 7 PCBs in sediments. Therefore, further to experience related to the preparation of the assessments within the 2023 MED QSR, the EAC value of 67,9 is included to present the sum of 7 individual IMAP PCB congeners.

Ongoing efforts focus on establishing an improved methodology for setting the Environmental Assessment Concentration (EAC) for IMAP Common Indicator 17 at the regional and the sub-regional level subject to data availability. These efforts also include proposing the new area-specific species, contaminants, and emerging contaminants of concern recommended to strengthen pollution monitoring in the Mediterranean.

Assessment of Contaminants in sediments and biota

For chemical contaminants, trends analysis and distribution levels for the assessment could be carried out on sub-regional and/or regional level, provided appropriate quality control assured datasets are available.

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For the assessment of contaminants in sediments and biota conducted as part of the preparation of the 2023 MED QSR, different assessment methodologies were employed for the evaluation of CI 17, based on the data availability provided by the Contracting Parties (CPs) across the four Mediterranean Sub-regions. The Mediterranean Sea is divided into four main sub-regions based on available database sources to facilitate the development of pollution assessment criteria. This process began with the preparation of the UNEP/MAP 2011 Initial Integrated Assessment, followed by the Med QSR 2017, and most recently, the 2023 MED QSR assessments. These sub-regions are: the Western Mediterranean, the Adriatic Sea, the Central Mediterranean, and the Aegean and Levantine Seas.

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

The integrated NEAT GES assessment for CI 17 across all sub-regions was not feasible due to the high heterogeneity of data types, spatial coverage, and the lack of quality-assured, homogeneous data. As a result, the NEAT methodology was applied to the Adriatic Sea Sub-region and later to the Western Mediterranean Sub-region, based on the monitoring areas defined by the concerned CPs and the harmonization of scale approaches among the Contracting Parties.

For some subregions of the Mediterranean Sea, it was possible to define IMAP spatial assessment units (IMAP SAUs) based on the distribution of monitoring stations (e.g. Adriatic Sea, Western Mediterranean Sea), while for others with insufficient data reported for GES assessment this was impossible. A quality status assessment for all areas is needed either on a SAU level or alternatively on individual monitoring stations level. The NEAT methodology supports assessments in areas where SAUs are defined (e.g. Adriatic Sea; Western Mediterranean Sea). For areas where this is impossible, the CHASE+ (Chemical Status Assessment Tool) methodology was applied for assessment at the monitoring stations level.

The NEAT assessment methodology strikes a balance between overly broad scales, which may obscure significant areas of impact in specific regions or sub-regions, and excessively fine scales, which could complicate the assessment process. This methodology was applied at the IMAP CIs 17 for monitoring data collected per each Spatial Assessment Unit (SAU) and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately, considering the temporal coverage of monitoring data used again per each SAU and per environmental matrix (sediments, biota) and per contaminant group (trace metals (TM), PAHs, PCBs) separately.

The 4-level and 3-level nesting approaches were implemented in the Adriatic Sea Sub-region and Western Mediterranean Sub-region, respectively. This resulted in the aggregation and integration of assessment results within the IMAP nested scheme at the following levels:

1. IMAP national Spatial Assessment Units (SAUs) and sub-SAUs (the finest level)
2. IMAP coastal and offshore assessment zones of sub-divisions
3. Sub-division and sub-regional levels (e.g., Adriatic Sea).

For setting the IMAP assessment areas for CIs 13 and 14, the finest areas defined for CI 17 were adjusted to serve the purpose of eutrophication assessment.

The scope of all SAUs and sub-SAUs was defined and introduced into the NEAT tool, along with their respective codes and surface areas (in km²). Within each SAU under ‘habitats’ the sediments and biota are introduced. Under ‘ecosystem component’ the 5 chemical compounds of CI 17 are assigned. For each SAU and ‘Ecological Component’ (EO9 contaminants in our case) and ‘Habitat’ (sediments, biota), average value and standard deviation per chemical compound is inserted. While

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arithmetic means and standard errors were used for CI 17, geometric means and standard errors were applied for CIs 13 and 14.

Boundary limits and class threshold values per SAU, parameter, and matrix are applied according to the assessment scale presented in the section on targets. The aggregation of the 5 chemical compounds of CI17 was carried out to derive a single status value (NEAT value) for all levels of the nesting scheme. The aggregation of the assessment results for these compounds resulted in a NEAT value per specific SAU, which was then spatially integrated into the sub-divisions and regional levels. The assessment results were presented and visualized using a tabular format and graphical representations generated with a GIS tool.

In the absence of sufficient *in situ* data reported for the Central Mediterranean, and Aegean and Levantine Seas Sub-regions, **the CHASE+ (Chemical Status Assessment Tool) methodology** was tested and then applied in these sub-regions. Its application was based on the experince of the European Environmental Agency (EEA) to assess environmental status categories for the European Seas (Andersen et al. 2016, EEA 2019)[25].

The first step in this tool is to calculate the ratio $C_{measured}/C_{threshold}$ (C is the concentration) called the contamination ratio (CR) for each assessment element in a matrix. Then a contamination score (CS) is calculated as follows[26]:

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

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

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 are classified according to the assessment scale presented above in the section on targets.

In order to avoid possible bias in the Mediterranean regional assessment that may occur as a result of the use of different assessment methodologies in different areas, comparisons and harmonization of the NEAT and the CHASE+ assesmnet methodologies were perfomed. It ensured reducing uncertainty and achieving harmonization across assessments conducted in different sub-regions and sub-divisions, despite variations in the number of sampling locations and measurements.

Further details are provided in the thematic assessments **of contaminants** in sediments and biota and the 2023 MED QSR Pollution Assessment.

Known gaps and uncertainties in the Mediterranean

Important development areas in the Mediterranean Sea over the next a few biennia included harmonization of monitoring targets (determinants and matrices) within assessment at sub-regions scales, development of suites of assessment criteria, and review of the scope of the national monitoring programmes to ensure that those contaminants which are considered to be important within each assessment area are included. Through these and other actions, it was possible to develop targeted monitoring programmes tailored to meet the needs and conditions within each GES assessment sub-region. It was recognized that the open and deep sea is much less covered by

[25] Andersen, J.H., Murray, C., Larsen, M.M., Green, N., Høgåsen, T., Dahlgren, E., Garnaga-Budrė, G., Gustavson, K., Haarich, M., Kallenbach, E.M.F., Mannio, J., Strand, J. and Korpinen, S. (2016) Development and testing of a prototype tool for integrated assessment of chemical status in marine environments. Environmental Monitoring and Assessment 188(2), 115.
EEA (2019) Contaminants in Europe's Seas. Moving towards a clean, non-toxic marine environment. EEA Report No 25/2018.

[26] 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'.

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monitoring efforts than coastal areas. Therefore, within monitoring programmes also areas beyond the coastal areas were included in a representative and efficient way (where risks warrant coverage).

By building on the achievements up to 2023, during the preparation of the 2023 MED QSR, several knowledge gaps were identified in the monitoring and assessment of Common Indicator 17, which need to be addressed following the recommendations of the 2023 MED POL Focal Points Meeting.

Update of Environmental Assessment Criteria (EACs):

In order to update EACs, the methodology, as detailed in the European Commission Guidance Document (2018) and in Long et al. (1995), should be considered. This entails the creation of a database of scientific literature which elaborates where adverse biological effects, or no effect, are presented in conjunction with chemical data, in the environment and biota, at the same site and time. Briefly, those include but are not limited to sediment toxicity tests, aquatic toxicity tests in conjunction with equilibrium partitioning (EqP) and field, and mesocosm studies. The literature would then be analysed by experts and conclusions drawn. Laboratory results on biomarkers (CI18) are also important for the derivation of the EAC values. The emphasis should be given to the Mediterranean Sea biota species. These efforts are needed to ensure the revised Environmental Assessment Criteria supports integration of toxicity considerations into future GES/non-GES/ environmental assessments. In this regard, not only traditional contaminants should be considered, but also, optionally other contaminants found in the environment.

Undertake regular updates of Sub-regional and regional Background Concentrations (BCs) and Background Assessment Criteria (BACs):

As more data will be submitted to IMAP IS, the Sub-regional and regional BCs should be updated. It is proposed to undertake their regular updates at least 2 years prior to the QSRs preparation. This will allow for sufficient time to analyse the data, detect data gaps and ensure the submission of missing data, to perform a more robust update of the criteria for reliable assessments.
The methodology for BACs calculation should be revised and updated. BACs are calculated from BCs by applying the multiplication factors. Due to the lack of Mediterranean data, UNEP/MAP adopted the pragmatic methodology used by OSPAR.[27] Therefore, the precision of monitoring per CP should be calculated and used to set the multiplication factors specific for the Mediterranean.

Improve the GES assessment:

Revision of IMAP needs to support the improvement of the good environmental status assessment and contribute to a more robust analysis, and facilitate integration and aggregation of CI 17 with other CIs and EOs, by undertaking the following priority actions:

- Update list of priority pollutants. Measurements of known contaminants of concern, such as As and Cu, and contaminants of emerging concern, such as pharmaceuticals and flame retardants should be considered for inclusion in the IMAP Pollution monitoring. This process should follow the initial steps undertaken in 2019.[28] The updated List of Priority Contaminants could provide the basis for a prioritization of substances to be further included in the IMAP Guidance Factsheets related to Ecological Objective 9, and complement presently agreed mandatory or recommended substances for CIs 17 and 20.

[27]OSPAR calculated the ratio between BAC and BC (the multiplication factor) from known parameters. The pragmatic approach used in order to have 90% probability of concluding that concentration is below provided for BAC, BAC = BC exp (3.18 CV), where CV is the precision of the monitoring program (per determinant and matrix). In the case of OSPAR, temporal monitoring data from the UK National Marine Monitoring Programme was considered.

[28] UNEP/MED WG.463/Inf.4. The List of Priority Contaminants under MAP/Barcelona Convention within the MED POL Monitoring Programme and IMAP have been revised according the latest lists of priority contaminants development in the EU region and internationally and shows no major changes compared to other RSCs.

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The decision on which contaminant to add should be based on pilot studies checking the probability of their presence in the Mediterranean Sea sub-regions.

- Extend the list of commonly agreed IMAP Pollution mandatory species. Species, other than species (*M. galloprovincialis* and *M. barbatus*) presently mandatory, should be added to the IMAP list. The species should be chosen based on their presence in the Sub-regions and their relevance as pollution indicators, which in turn will allow for an improved environmental assessment. Harmonization of the use of different species in different Sub-regions needs to be followed by setting the criteria (BCs and BACs) specific to each species.
- Utilize tools to perform Environmental Risk Analysis, to integrate chemical and biological data, as elaborated here-below for CI 18.
- Revise sediments` temporal monitoring requirements. For hot spot stations, the monitoring should remain every year or 2 years, while for other stations, the monitoring once or twice during the 6-year cycle should be considered.
- Harmonize national efforts regarding contaminants monitoring. As a minimum, it is necessary to ensure that every CP reports all mandatory parameters in mandatory matrixes, including the wet weight for mussels, LOD or LOQ values, the grain size of samples for sediments, and spatial and temporal monitoring requirements. The significant differences among the countries in terms of LOD and LOQ values, as well as differences among the areas of monitoring in the same CP, need to be analyzed and drivers of the unsatisfactory analytical performance identified.

Contacts and Version Date

http://www.unepmap.org

Version No	Date	Author
V.1	31.05.17	MEDPOL
V.2	11.09.17	MEDPOL
V.2	12.12.18	MEDPOL
V.4	31/05/2019	Approved by the Meeting of MED POL FPs
Final versión	09/09/2019	Approved by the 7^{th} Meeting of EcAp Coordination Group
V4	28/05/2025	Joint CorMon Pollution and ML Meeting
V5		Approved by the Meeting of MED POL FPs
Final version		Approved by the 12^{th} Meeting of EcAp Coordination Group

9. The revision of IMAP **Common Indicator 18 (EO9)**: “Level of pollution effects of key contaminants where a cause and effect relationship has been established” is presented in the table bellow.

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)[29]**
Concentrations of contaminants are not giving rise to ~~[~~negative effects on health status of marine biota~~] []~~	Effects of released contaminants are minimized	State: • Contaminants effects below thresholds. ~~[~~Pressure:] • Decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and offshore activities.

Rational

Justification for indicator selection

Biomarkers are used to infer on a cause-effect relationship between a stressor and a biotic effect. The biotic effects can be biochemical, physiological, toxicological and/or be detected at the ecological/community level. The World Health Organization (WHO, 1993) further defined biomarkers as: (1) a biomarker of exposure and (2) a biomarker of effect (Lomartire et al. 2021).

Biological effects monitoring has been progressively integrated into IMAP-based national monitoring programmes. It is essential to further expand and enhance the application of biological effects methods, including the integration of chemical and biological effects monitoring and assessment, in order to adequately address Ecological Objective 9 (EO9).

Upon exposure to certain dose of harmful contaminants, marine organisms start manifesting a number of symptoms that are indicative of biological damage, the first ones appearing after a short while at the sub-cellular level. These 'sub lethal' effects, when integrated, often converge to visible harm for the organisms and possibly to the whole population at a later stage, when it will be too late to limit the extent of biological damage resulting from environmental chemical exposure and ecosystems deterioration. Most of these symptoms have been reproducibly obtained in the laboratory (at high dose) and the various biological mechanisms of response to major xenobiotics are now sufficiently well documented. In the latest decades, scientific research has been intensified towards these alternative cellular and sub-cellular methods for integrated pollution monitoring, despite it revealed a more complex panorama with samples exposed to environmental concentrations, which includes a number of confounding factors hindering the cost-effective and reliable determination of biological effects at cellular and sub-cellular levels.

As a consequence, most of these methods (biomarkers), based on the chemical exposure to biological effects cause relationships, are envisaged to monitor hotpots stations, dredging materials assessments,local damage evaluations and other sites of particular concern. .

Ongoing research (biomarkers, bioassays) and future research trends, such as 'omics' developments, will further define the indicators and the methodologies for these common indicators for toxicological effects.

Biomarkers are classified as per the expected protection/defense response, including the most used as collected from the recent literature for the Mediterranean Sea, as presented below in the Section on Indicator Definition.

[29] Following the decisions to be made at the present meeting regarding minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3/Rev.1, the revised Targets will be incorporated into the revised IMAP Pollution Indicators Factsheets.

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)

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Policy Context and Targets

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)

Policy context description

In most Mediterranean countries, the monitoring of a range of hazardous chemical substances in different marine compartments are undertaken in response to the UNEP/MAP Barcelona Convention (1976) and its Land-Based Protocol, through the coordination of the UNEP/MAP MED POL Monitoring Program. For Mediterranean EU countries, the European legislation on the Marine Environment also applies (e.g. EU WFD and EU MSFD), as well as other international and national policy drivers. A considerable amount of founding knowledge and actions are available through the pollution monitoring and assessment component of the UNEP/MAP MED POL Programme during the past decades until today, including monitoring pilot programmes (Eco-toxicological effects of contaminants). The environmental assessments have been used for the identification and confirmation of significant marine contaminants effects on biota and therefore, impacts on biodiversity; as well as, for the continuous development of monitoring strategies and guidance. With respect to the Ecosystem Approach and IMAP, their implementation will continue under the benefits gained from this past knowledge and the policy and practical framework built in the Mediterranean Sea.

The 2017 MED QSR assessment identified significant knowledge gaps, emphasizing the need for future development efforts in the Mediterranean Sea to focus on several key areas. These include validating the added value of biomarkers as 'early warning' indicators in long-term marine monitoring, testing innovative research-based tools such as ‘omics’ technologies, harmonizing analytical quality standards, and developing comprehensive assessment criteria that integrate chemical and biological methods. Additionally, a review of the scope and effectiveness of current biological effects monitoring programmes is recommended. Together, these actions will support the design of targeted and effective monitoring strategies aligned with CI18 requirements under the IMAP framework and GES assessments.

In light of the above, progress was made in 2021 with the proposal agreed by the Ecosystem Approach Correspondence Group on Pollution Monitoring to integrate data from CI-18 (Biomarkers) and CI-17 (Chemical Monitoring) into the assessment process. The proposed methodology combines the effects of single chemical pollutants, to take into consideration possible additive or synergistic environmental effects among them and then evaluate the risk to marine organisms exposed to the pollutants in water and sediments. The integration procedure consists of three modules: (i) a chemical module for integration of the data concerning the concentration of the pollutants; (ii) an ecotoxicological module that integrates data of the biological effects in marine organisms; and (iii) an integration module that combines the two lines of evidence in an Environmental Risk Index.

Evaluation of the environmental risk is usually obtained by an “expert judgement of a panel of qualified environmental scientists. Applying the Environmental Risk Index will result in objective risk values which allow national and regional policy makers and environmental managers to decide on required actions to decrease marine contamination, or to remediate a polluted area. The effectiveness of these actions can subsequently be monitored and quantified until an acceptable Environmental Risk Index is achieved. However, this approach still cannot be applied given lack of data reporting and capacities at the national level.

Targets

The GES targets under Common Indicator 18 need to maintain the contaminants effects below threshold further to decreasing trend in the operational releases of oil and other contaminants from coastal, maritime and off-shore activities.

The present lack of data availability in the IMAP Integrated Monitoring and Assessment Programme (IMAP IS) and relevant scientific studies does not allow for the proposal of a boundary limit between Good Environmental Status (GES) and non-GES status of CI 18. This boundary limit should primarily follow on progress in determining or updating the Background Assessment

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)
Concentrations (BAC) and Environmental Assessment Criteria (EAC) for biomarkers in the selected pilot sub-region(s)/sub-division(s) based on studies and *in situ* biomarker data. All relevant national and international practices and sources need to be considered, along with gathering information on biomarkers including relevant information, such as citation, type of test, biological effect measured, analytical approach used, study area, test duration, species/tissues tested, chemical concentrations, and other pertinent details.	

Policy documents

General Policy documents

Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9).

Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28).

Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027.

Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.

Decision IG.24/4 (COP21, 2019) on Assessment Studies.

Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (EU Marine Strategy Framework Directive and updates in 2010).

Commission Directive (EU) 2017/845 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies

Commission Decision (EU) 2017/848 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (and updated revisions).

Commission Decision (EC) No 2013/480/EU establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise and repealing Decision 2008/915/EC.

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Biological Effects related Policy documents

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~~UNEP/MAP WG.509/27 (2021). Monitoring Guidelines/Protocols for Sampling and Sample Preservation of Marine Molluscs (such as Mytilus sp.) and Fish (such as Mullus barbatus) for IMAP Common Indicator 18. Meeting of the MED POL Focal Points, Videoconference, 6-7 October 2021.~~

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UNEP/MAP WG.509/43 (2021) – Report of the Meeting of the MED POL Focal Points, 27–28 May and 6–7 October 2021, Annex III, Appendices 22–24, p. 2514.

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Indicator analysis methods

<table>
<tr><td>Indicator Title</td><td>Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)</td></tr>
<tr><td colspan="2">Indicator Definition

In marine bivalves (such as Mytilusgalloprovincialis) and/or fish (such as Mullus barbatus)

Lysosomal Membrane Stability (LMS) - biomarker of membrane integrity used as general screening of contaminant exposure stress.

Acetylcholinesterase (AChE) - enzyme involved in impulse transmission, providing assay as a method for assessing neurotoxic effects, metabolism impairment and immune disturbance in marine animals.

Micronucleus assay test (MN frequency) - a tool for assessing cytogenetic/DNA damage in marine organisms.

Sub-indicators:

In addition to the biomarkers listed above for monitoring IMAP Common Indicator 18, the sub-indicators also include the following biomarkers, classified according to the expected protection/defence responses. Biomarkers highlighted in bold are included in the IMAP Common Indicator 18 Data Standards (DSs). Their classification (mandatory or additional/non-mandatory), along with the relevant organism and tissue for testing, is provided in the table below. All other parameters required for reporting data under IMAP Common Indicator 18 are outlined in the Common Indicator 18 Data Standards (DSs)..

<s>Lysosomal Membrane Stability (LMS)- Neutral red retention time (NRRT) assay.</s>
Metallothionein (MTs). An increase of the cellular MT-protein level is considered as a protective effect against an excess of harmful metals.
Stress on Stress (SoS), the survival on air is a general method to determine the physiological condition in bivalves.
Antioxidant defense enzymes: Superoxide dismutase (SOD) that eliminates superoxide anion, catalase (CAT) and glutathione peroxidase (GPx) which remove hydrogen peroxide and glutathione reductase (GRd) which regenerates glutathione (GSH), an important non-enzymatic antioxidant against ROS (reactive oxygen species).
Detoxification enzymes: CYP1A1 (frequently measured as ethoxyresorufin-O21 deethylase (EROD) activity and glutathione-S-transferase (GST),
<s>Aldehyde, formed from oxidative damage to lipids – malondialdehyde accumulation levels (MDA),</s>
Butyrylcholinesterase enzymatic activity (BChE),
Detoxifying enzyme Carboxylesterase (CE) activity - potential biomarkers of chemical exposure, as they are an important family of enzymes involved in the metabolism of xenobiotic and endogenous compounds.
Expression of vitellogenin (VTG), a lipoprotein produced in female fish and used as a biomarker for endocrine disruption.
Metabolic biomarkers: Electron Transport System activity (ETS) and glycogen reserves (GLY).
Lactate dehydrogenase (LDH), and citrate synthase (CS): biomarkers for anaerobic and aerobic metabolism.
OMICS, in particular Transcriptomics, a key branch of OMICS.
Oxidative damage markers: lipid peroxidation (LPO) and protein carbonyl derived levels (CARB).
Phase I detoxifying enzyme - 7-benzyloxy-4-[trifluoromethyl]-coumarin-O-debenzyloxylase (BFCOD).
</td></tr>
</table>

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)

- Histopathological alteration
- DNA damage – single-cell gel electrophoresis (SCGE) or Comet Assay, DNA adducts et other.

Biomarker	**Description (EN)**	**Organism**	**Tissue**	**Mandatory**	**Additiona (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	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

Methodology for indicator calculation

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)

Lysosomal Membrane Stability (LMS): Biological techniques (neutral red retention), including microscopy

Acetylcholinesterase (AChE) assay: Biochemical techniques, including spectrophotometry

Micronucleus assay: Biochemical techniques, including microscopy

Additional parameters to be recorded: biometrics (size/length, age), biological parameters such as condition index (mussels), condition factor, gonadosomatic index, hepatosomatic index (fish) and data on temperature, salinity and oxygen dissolved.

The detailed analytical procedure for the biomarkers ~~contaminants~~ regulated under CI 18 and other related mandatory parameters, including sampling and sample transportation, analytical determination of indicators and sub-indicators, and data quality control are outlined in C-1. Monitoring Guidelines/Protocols for sampling and analysis of biomarkers in marine molluscs (such as Mytilus sp.) and fish (such as Mullus barbatus).

Indicator units

(retention) (labilization period) minutes - Lysosomal Membrane Stability (LMS)

nmol/min mg protein in gills (bivalves) or muscle (fish)- Acetylcholinesterase (AChE) assay

number of cases, ‰ in haemocytes“ (bivalves) or erythrocytes (fish) - Micronucleus assay

Data Standards for IMAP CI 218 elaborates units for all mandatory and other chemicals and parameters

List of Guidance documents and protocols available

IMAP Monitoring Guidelines/Protocols (https://www.iaea.org/about/organizational-structure/department-of-nuclear-sciences-and-applications/division-of-iaea-environment-laboratories/marine-environmental-studies-laboratory/unep-map-med-pol-integrated-monitoring-and-assessment-programme-imap-monitoring-guidelines)

- C-1. Monitoring Guidelines/Protocols for sampling and analysis of biomarkers in marine molluscs (such as Mytilus sp.) and fish (such as Mullus barbatus);
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.

European Commission, 2014. Technical report on effect-based monitoring tools. Technical Report 2014 – 077. European Commission, 2014.
UNEP/RAMOGE: Manual on the Biomarkers Recommended for the UNEP/MAP MED POL Biomonitoring Programme. UNEP, Athens, 1999.

Indicator Title	Common Indicator 18. Level of pollution effects of key contaminants where a cause and effect relationship has been established (EO9)

UNEP/MAP, 2005. Fact sheets on Marine Pollution Indicators. Meeting of the UNEP/MAP MED POL National Coordinators. Barcelona, Spain, 24-27 May 2005. UNEP(DEC)/MED/ WG.264/ Inf.14. UNEP, Athens.
ICES Cooperative Research Report. No.315. Integrated marine environmental monitoring of chemicals and their effects. I.M. Davies and D. Vethaak Eds., November 2012.

Data Confidence and uncertainties

Selected analytical validated methods should be subject to Quality Assurance Protocols and interlaboratory exercises: QA/QC.

Up to 2023, the IAEA/MESL, in collaboration with the UNEP/MAP - MED POL, implemented 56 interlaboratory comparisons/proficiency tests for the analysis of trace elements and organic contaminants, as well as 64 training courses on the analysis of trace elements and organic contaminants in marine samples. At its 2021 meeting, the Ecosystem Approach Correspondence Group on Pollution Monitoring agreed on the scope of an intercalibration exercise to support quality assurance related to IMAP Common Indicator 18. This included the intercalibration of Lysosomal Membrane Stability (LMS), Micronuclei frequency (MNi), Acetylcholinesterase activity (AChE), and Stress on Stress (SoS), as well as the organization of a training course aimed at strengthening the implementation of IMAP Common Indicator 18.

However, the implementation of this intercalibration component for CI 18 could not be carried out in collaboration with IAEA/MESL, due to the absence of the specific technical and scientific expertise required.. Further efforts are required to establish an intercalibration exercise for IMAP Common Indicator 18.This may involve exploring alternative models for organizing intercalibration tests with partners other than IAEA/MESL, as well as considering different modalities such as ring tests.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

With regard the Ecosystem Approach and IMAP implementation, there are considerable benefits to be gained from taking advantage of previous knowledge and information developed through the UNEP/MAP MED POL. These actions include (1) the use of existing experience in the design of monitoring programmes, (2) the use of existing guidance on sampling and analytical methods to inform technical aspects of ecosystem approach monitoring, (3) the use of existing sampling station networks as a framework for the ecosystem approach monitoring networks, (4) the use of existing statistical assessment tools and work on assessment criteria as the basis for the assessments of ecosystem approach data, (5) the use of existing data to describe the distributions and levels of contaminants and effects against EACs and reference concentrations , and (6) the use of existing time series as the basis of monitoring against a "no deterioration" target. The availability of quality assured data is essential for the assessment of levels and trends, and thus, their comparability overtime and across spatial scales.

Building on elements elaborated in the Integrated Monitoring and Assessment Programme (2016 IMAP), including the above-mentioned components, the Monitoring Guidelines—structured around the specific technical protocols related to IMAP Common Indicator 18 —were comprehensively developed by the MED POL Programme in cooperation with IAEA/MESL. These guidelines were approved by the MED POL Focal Points Meeting (2021).They build upon the knowledge and practices obtained over 40 years of MED POL monitoring implementation and recent publications, highlighting the current practices of the Contracting Parties' marine laboratories, as well as other Regional Seas Conventions and the EU. A thorough analysis of presently available practices of UNEP/MAP, UNEP and IAEA, as well the HELCOM, OSPAR and European Commission Joint Research Centre was undertaken to assist an innovative approach for preparation of the IMAP

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Monitoring Guidelines/Protocols. The monitoring methodologies and practices are elaborated for sampling, sample preservation and transportation, sample preparation and analysis, along with quality assurance and reporting of monitoring data, for their use by the IMAP competent laboratories in order to ensure the representativeness and accuracy of the analytical results. These guidelines present a summary of the best available known practices employed in marine monitoring by bringing integrated comprehensive analytical practices that can be applied in order to ensure the representativeness and accuracy of the analytical results needed for generation of quality assured monitoring data.

The Monitoring Guidelines for IMAP Common Indicator 18 outline the following monitoring and reporting practices:

- C-1. Monitoring Guidelines/Protocols for sampling and analysis of biomarkers in marine molluscs (such as Mytilus sp.) and fish (such as Mullus barbatus).
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.

Available data sources

i. IMAP Info System (http://imapinfosystem.info-rac.org/app/#/) – once datasets will be reported for CI 18 (the MEDPOL Pilot Biomonitoring Program (presently with only a few countries reporting data by 2005) and one dataset reported by a Contracting Party in 2023).
ii. Recently reviewed literature, due to the absence of in situ data reported for CI 18, as elaborated in the CI 18 thematic assessment and the 2023 MED QSR Pollution Assessment
iii. Additional potential data sources:The new scientific literature sources providing data on the no effect or adverse biological effects, in conjunction with chemical data from the environment and biota at the same site and time (to be made available during the revision of the EAC for IMAP Common Indicator 17).
iv. The data and information derived from the execution of EU-funded research programmes related to the biological effects of environmental pollution in marine and coastal ecosystems.
v. Studies and results from biological effects monitoring, as available from the International Council for the Exploration of the Sea (ICES), the OSPAR Commission, and the Baltic Marine Environment Protection Commission (HELCOM).

Spatial scope guidance and selection of monitoring stations

The spatial scope for monitoring should include reference and coastal long-term master stations, including offshore, as applicable, distributed spatially as relevant and include local spatial refinements, such as transect sampling, and therefore, is a direct function of the risk-based assessments and the long-term monitoring purpose. The selection of the sampling sites for the monitoring of biological effects in the marine environment should consider:

- Risk areas of concern identified on the basis of the review of the existing information.
- Vulnerable areas of known past and/or present release of chemical contaminants.
- Offshore areas where risk warrants coverage (aquaculture, offshore oil and gas activity, dredging, mining, dumping at sea and others).
- Monitoring sites representative of other sources, such as shipping and atmospheric inputs.
- Reference monitoring sites: to establish scale-based reference values and background concentrations.
- Monitoring sites representing sensitive pollution sites/areas at national and sub regional scale.

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- Monitoring sites in deep-sea sites, offshore stations (sediments)and areas of potential particular concern.

The selected sites should allow the collection of a realistic number of samples over the years (e.g. allow to sample sufficient number of biota for the selected species during the duration of the programme). It is essential that the monitoring strategies are being coordinated at regional and/or sub regional level, in particular with chemical monitoring. The coordination with monitoring for other Ecological Objectives is crucial for cost-effective and future integrated assessment.

Temporal Scope guidance

Sampling frequencies is determined according the current status of the pilots and national marine monitoring programmes:

INITIAL PHASE of IMAP MONITORING (PILOT): to identify monitoring stations to collect BIOTA (bivalves, such as *Mytilus galloprovincialis*) on a yearly basis (or higher frequencies if the environmental variability study needs to be carried out), and in the same manner as for chemical monitoring, focusing on few locations such as hotspots and reference stations.

ADVANCED PHASE of IMAP MONITORING: when fully completed IMAP Initial Phase implementation with the ongoing data reporting on biological effects, the objective should be the integration of the chemical and biological monitoring on a efficient manner in line with the integration of data from CI-18 (Biomarkers) and CI-17 (Chemical Monitoring) into the assessment process as agreed by the Ecosystem Approach Correspondence Group on Pollution Monitoring. Therefore, a refinement of the successful strategies for biological effects long-term monitoring should be implemented and maintained based on the experiences from developing pilot monitoring activities (Initial Phase). Sampling should include the yearly collection of both bivalves, such as *Mytilus galloprovincialis*, and fish, such as *Mullus barbatus*.

For trend determinations the sampling frequencies will depend on the ability to detect trends considering the environmental and the analytical variability (ca. total uncertainty). It can be possible to decrease the sampling frequencies in cases where established time trends and levels show concentrations well below levels of concern, and without any upward trend over a number of years.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation – Assessment Criteria

Monitoring should allow the necessary statistical data treatments and long-term time-trend analysis. Deriving and setting up the assessment criteria to determine environmental status is not an easy task. It gets more complicated going from the local to sub-regional and regional assessments.

The BAC and EAC values for IMAP Common Indicator 18 were not updated by Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean given the lack of data reported for biomarkers. Therefore, these criteria remain as endorsed in Decisions IG.22/7 and IG.23/6 and are shown table here-below. The Mediterranean EACs for Biomarkers remains based on OSPAR values.

Decision IG.23/6 provided the calculation of BAC values, and an update of EAC values, for Stress on Stress (SOS) and Micronuclei Frequency (MN) by using datasets from reference stations submitted by Contracting Parties in 2015.

Laboratory results on biomarkers (CI18) are also important for the derivation of the EAC values for CI 17.

Mediterranean BACs and EACs for biomarkers in mussel (*M. galloprovincialis*) as endorsed by Decisions IG.22/7 and IG.23/6.

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Biomarkers/Bioassays and units	BACs IG.23/6 in Mussels (*Mytilus galloprovincilais)*	EACs IG.23/6 in Mussels (*Mytilus galloprovincilais)*	BACs IG.22/7 in Mussels (*Mytilus galloprovincilais)*	EACs IG.22/7 in Mussels (*Mytilus galloprovincilais*)
Lysosomal membrane stability Neutral Red Retention Assay (minutes)			120[a*]	50 [a*]
Lysosomal membrane stability Cytochemical method (minutes)			20 [a*]	10 [a*]
AChE activity (nmol min-1 mg-1 protein) in gills (French Mediterranean waters)			29	20
AChE activity (nmol min^{-1} mg^{-1} protein) in gills (Spanish Mediterranean waters)			15	10
Stress on Stress (days)	11	5		
Metallothioneins (µg/g digestive gland)	247			
Micronuclei frequency (number of cases /1000 cells) in haemocytes)	1			

[a]Technical annex: assessment criteria for biological effects measurements. Integrated monitoring of chemicals and their effects. ICES Cooperative Research Report No. 315. Davies, I.M. and Vethaak, A.D.Eds.
**Moore et al., 2006 (Standard values adopted by ICES)*

Ongoing efforts focus on establishing an improved methodology for determining Background Assessment Concentrations (BAC) and Environmental Assessment Criteria (EAC) for biomarkers at regional and sub-regional levels, depending on data availability. These efforts also include proposing new biomarkers to enhance the monitoring and assessment of CI 18.

Alongside the application of environmental status for CI 18 using BAC and EAC values, the assessment of effects through comparison of biomarker values at monitoring stations with those measured at control sites (monitored concurrently with the selected sampling stations) should be considered a valid alternative. This approach is particularly relevant in cases where the application of BAC and EAC values is not feasible, such as for antioxidant biomarkers.

Expected assessments outputs

For biological effects, trends analysis and distribution levels could be carried out on sub-regional level, provided appropriate quality assured datasets are available. For the integrated assessment of GES, it would be carried out using Mediterranean data from IMAP Info System and relevant scientific literatur sources and applying IMAP CI 18 assessment criteria

Due to the complete lack of data reporting into the IMAP Information System (IMAP IS) by the Contracting Parties (CPs), the assessment input for the 2023 MED QSR related to the status assessment of IMAP CI-18 was based on bibliographic studies. This approach mirrors the

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methodology used in the preparation of the 2017 MED QSR, updated with more recent scientific literature. The studies included in the review were selected according to the following criteria:

- Data derived exclusively from the Mediterranean Sea;
- Studies conducted since 2016 and published from 2018 onwards.

A total of 24 studies were retrieved from the scientific literature. In the Central and Western Mediterranean Sea (CEN and WMS), the biomarkers examined were either not listed under IMAP or, if listed, were not analyzed in the required organ or tissue as specified by IMAP guidelines. Most studies assessed multiple biomarkers at the same sampling stations, with inconsistent results—some showing effects and others not.

The mandatory monitoring species, *Mytilus galloprovincialis* and *Mullus barbatus*, were included in five and four studies, respectively. Additionally, ten fish species, six mollusc species, and two polychaete species were examined across the reviewed literature.

Among the biomarkers for IMAP CI-18:

- Acetylcholinesterase (AChE) was reported in 13 studies,
- Metallothionein (MT) in 5 studies (2 on molluscs, 2 on fish, and 1 on a polychaete species),
- Micronuclei (MN) in 2 studies,
- Lysosomal membrane stability via Neutral Red Retention Time (LMS-NRRT) in 1 study.

The most frequently reported additional biomarkers were:

- Catalase (CAT) in 15 studies,
- Malondialdehyde (MDA) in 12 studies,
- Glutathione S-transferase (GST) in 11 studies,
- Superoxide dismutase (SOD) in 9 studies,
- Glutathione peroxidase (GPx) in 8 studies.

Further details are provided in the thematic eutrophication assessments and the 2023 MED QSR Pollution Assessment.

Known gaps and uncertainties in the Mediterranean

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Further to the significant progress achieved over the last few biennia regarding the standardizing monitoring practices and progressing towards the environmental assessment tools, it is essential to ensure GES assessment for CI 18 . Revision of IMAP needs to support the good environmental status assessment for CI 18 and facilitate its integration and aggregation with other CIs and EOs, by undertaking the priority actions to address key gaps:

- Review and update the list of CI 18 biomarkers, along with the monitoring species;
- Review and update, as appropriate, the assessment criteria as adopted by Decisions IG.22/7 (COP 19) and IG.23/6 (COP 20), as well as the assessment methodologies;
- Further to the initial work undertaken in 2021 towards the development of the Biomonitoring related to IMAP CI 18, the following further actions should be tested:
  - i) An application of new biomarkers should be explored to support the strengthening of CI 18 monitoring and assessment.
  - ii) Use of the Environmental Risk Analysis should be provided by combing the chemical and ecotoxicological data, to support the evaluation of the risk related to marine organisms exposed to contaminated waters and sediments. It should result in objective risk values which allow national and regional policymakers and environmental managers to decide on the actions to decrease marine contamination, or to remediate a polluted area.

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Through these and other actions, it will be possible to develop targeted and effective monitoring programmes tailored to meet the needs and conditions within each GES assessment sub-region. It has been recognized that the open and deep sea is much less covered by monitoring efforts than coastal areas. There is a need to include within monitoring programmes also areas beyond the coastal areas in a representative and efficient way, where risks warrant coverage.		
Contacts and version Date		
http://www.unepmap,org		
Version No	**Date**	**Author**
V.1	31.05.17	MEDPOL
V.2	12.12.18	MEDPOL
V.3	31/05/2019	Approved by the Meeting of MED POL FPs
Final version	09/09/2019	Approved by the 7th Meeting of EcAp Coordination Group
V4	28/05/2025	Joint CorMon Pollution and ML Meeting
V5		Approved by the Meeting of MED POL FPs
Final version		Approved by the 12th Meeting of EcAp Coordination Group

10. The revision of IMAP **Common Indicator 20 (EO9)**: "Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood" is presented in the table bellow.

Indicator Title	Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)[30]**
Concentrations of contaminants are within the regulatory limits for consumption by humans.	Levels of known harmful contaminants in major types of seafood do not exceed established standards	State: • Concentrations of contaminants in foodstuffs are below the UNEP/MAP Environmental Assessment Criteria approved for the protection of human health, . • Decreasing trend in the frequency of cases of seafood samples above the approved UNEP/MAP

[30] Following the decisions to be made at the present meeting regarding minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3/Rev.1, the revised Targets will be incorporated into the revised IMAP Pollution Indicators Factsheets.

Indicator Title	Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9)	
		Environmental Assessment Criteria
Rational		
Justification for indicator selection 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 the well-known bioaccumulation of metals and organic compounds in commercial bivalve species (such as the Mytillus galloprovincialis in the Mediterranean Sea) or alkyl mercury compounds (methylmercury) in tuna fish, which should be increased by new and contaminants of emerging concern in the near future. The studies considered for the assessment of contaminants in seafood within the 2023 MED QSR reported concentrations of contaminants and compared them to EU regulations, while some also addressed national regulations as well as international regulations or advisories (De Witte et al. 2022). Most of the studies also provided risk assessments to human health from the consumption of seafood by calculating the estimated daily intake (EDI), target hazard quotient (THQ), total risk (HI), cancer risk, among others. This emphasizes that the risk to human health (and hence GES-non GES status) should not be evaluated based on the concentration of a single contaminant but should be evaluated together with other factors such as synergy with other contaminants, temporal and spatial scales.		
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Indicator Title	Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9)

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Indicator Title	Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9)

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Policy Context and Targets	

Policy context description

The understanding of the health risks to humans (maximum levels, intake, toxic equivalent factors, etc.) and the food safety prevention, including contaminants of emerging concern, through the consumption of potentially poisoned seafood is a challenge and a priority policy issue for governments, as well as a major societal concern. There are different initiatives and regulations at national and international levels mainly for the fishery economic sector, which have established public health recommendations and maximum regulatory levels for different contaminants in numerous marine commercial target species. Methylmercury poisoning continues as a global priority policy issue and in 2013 the Global Legally Binding Treaty (Minamata Convention on Mercury) was launched by UNEP. Further, the US Food and Drugs Administration, the European Food Safety Authority, as well as Food and Agriculture Organization (FAO), are also national and international authorities with regard seafood safety, respectively.

Within the current efforts to establish a baseline for measuring trends in contaminant concentrations in seafood, the JRC (2010) is considered, which suggests taking into account 'the frequency with which levels exceed regulatory levels, the actual levels that have been detected, the number of contaminants for which exceeding levels have been detected, and in parallel the origin of the contamination (geological versus anthropogenic, local versus long distance).' It also stipulates that 'Further, an intake assessment considering the importance of the species showing exceeding levels in the human diet could be taken into account. If regulatory levels are exceeded in one species, it does not mean that all seafood consumption from this sub-region is dangerous.' The literature search on seafood quality in the Mediterranean Sea in preparation for the 2023 MED QSR focused on studies reporting data from 2016/2017 onward, emphasizing contaminants regulated in the EU. Another point to note is that recent literature emphasizes the connection between seafood safety and quality and the presence of microplastics in the marine environment (i.e., Wakkaf et al. 2020, among many others). The human health may be impacted either by consuming seafood with microplastic content, or seafood with contaminants that were leached from the microplastic to the organism.

Targets

The GES targets under Common Indicator 20 need to maintain the chemical contaminants of human health concern under regulatory levels in seafood as agreed by national and international authorities and their trends with regard their occurrence should decrease pointing towards zero events.

The present lack of data availability in the IMAP Integrated Monitoring and Assessment Programme (IMAP IS) for and relevant scientific studies does not allow for the proposal of a boundary limit between Good Environmental Status (GES) and non-GES status of CI 20. The boundary limit should primarily be based on the frequency of contaminants' occurrence. However, more substantial considerations need to be undertaken following the expected future availability of sufficient data reported by the Contracting Parties (CPs), in order to propose a GES–non-GES boundary limit. All relevant national and international practices need to be considered, along with gathering information on the cumulative impact of the contaminants on different seafood species and conducting calculations of daily/monthly intake and related risk analysis.

Policy documents

General Policy documents

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Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9).

Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28).

Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9).
Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28).
Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027.
Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria.
Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.
Decision IG.24/4 (COP21, 2019) on Assessment Studies.
Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.
Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (EU Marine Strategy Framework Directive and updates in 2010).

Commission Directive (EU) 2017/845 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies

Commission Decision (EU) 2017/848 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (and updated revisions).

Commission Decision (EC) No 2013/480/EU establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise and repealing Decision 2008/915/EC.

2017 Mediterranean Quality Status Report, https://www.medqsr.org/node/10/

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Contaminants in Seafood related Policy documents

Commission Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs.

Commission Regulation (EC) No 835/2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for polycyclic aromatic hydrocarbons in foodstuffs.

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.

Commission Decision (EC) No 2013/480/EU establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system

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Global Legally Binding Treaty (Minamata Convention on Mercury) http://www.mercuryconvention.org/

Joint FAO/WHO Expert consultation on the risk and benefits of fish consumption. FAO Fisheries and Aquaculture Report No. 978. ISSN 2070-6987. Rome, January, 2010.

List of maximum levels for contaminants in foods set by the FAO/WHO Codex Alimentarius Commission can be found at ftp://ftp.fao.org/codex/Meetings/cccf/cccf7/cf07_INFe.pdf

OSPAR Commission, 2013. Levels and trends in marine contaminants and their biological effects - CEMP Assessment Report 2012. Monitoring and Assessment Series, 2013

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US FDA http://www.fda.gov/Food/FoodborneIllnessContaminants/Metals/ucm115644.htm

Indicator analysis methods

Indicator Definition

Number of detected regulated contaminants* in commercial species.

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Proportion of detected regulated contaminants* exceeding regulatory limits.

Sub-indicators: other relevant chemicals and emerging pollutants are recommended to be carried out on a country decision basis.

*The list of all chemical and related parameters to be reported for IMAP CI 20 by the Contracting Parties is detailed in the Data Standards for IMAP CI 20. This list includes cadmium (Cd), mercury (Hg), lead (Pb), benzo(a)pyrene, and the sum of four polycyclic aromatic hydrocarbons (PAHs): benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, and chrysene. It also includes the sum of dioxins (WHO-PCDD/F-TEQ), the combined sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ), and the sum of six PCBs (ICES 6): PCB28, PCB52, PCB101, PCB138, PCB153, and PCB180. The concentration limits for regulated contaminants, as included in Data Standards and Data Dictionaries for IMAP CI 20, are provided in the section below titled *Statistical Analysis and Basis for Aggregation – Assessment Criteria*.

Non-regulated contaminants may also be included in the IMAP CI 20 monitoring programme; however, concentration limits for these substances have not yet been established under EU legislation.

Methodology for indicator calculation

Number of detected contaminants: monitoring by national regulatory and inspection bodies through statistics and databases.

Number of detected contaminants exceeding regulatory limits: monitoring by national regulatory and inspection bodies through statistics and databases.

The detailed analytical procedure for the contaminants regulated under CI 20 and other related mandatory parameters, including sampling and sample transportation, analytical determination of indicators and sub-indicators, and data quality control are outlined in D-1. Monitoring Guidelines/Protocols for Sampling and Determination of Contaminants in Seafood.

Indicator units

Concentration values of contaminants expressed in appropriate units of measurement, mg/kg w.w.= metals, and µg/kg w.w. = non-metals, as defined in Data Standards for IMAP CI 20.

Percentage (%) of detected regulated contaminants* exceeding regulatory limits out of the total number of measured contaminants.

Data Confidence and uncertainties

Up to 2023, the IAEA/MESL, in collaboration with the UNEP/MAP - MED POL, implemented 56 interlaboratory comparisons/proficiency tests for the analysis of trace elements and organic contaminants, as well as 64 training courses on the analysis of trace elements and organic contaminants in marine samples. Over 370 analytical laboratory practitioners have been trained at MESL. As of 2018, the scope of proficiency testing and training courses has been adjusted to meet the needs of Mediterranean laboratories in implementing monitoring programmes for trace elements (covering mandatory heavy metals – Cd, Hg, Pb, Cu in line with IMAP requirements, as well as additional elements such as Al, As, Co, Cr, Fe, Li, Mn, Ni, and Zn) and organic contaminants for IMAP Common Indicator 17 (covering mandatory organic contaminants including organochlorine (OC) pesticides, polychlorinated biphenyl congeners (PCBs), and polycyclic aromatic hydrocarbons (PAHs), also in accordance with IMAP requirements). Designated national laboratories participating in the proficiency tests receive, along with the sample, clear instructions on how to

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proceed with the PT sample and how to report the results. They are requested to use established analytical methods and are recommended to apply quality control and laboratory quality assurance procedures. The results of analyses of a matrix-matching quality control (QC) sample must be reported along with the results from the PT sample.

As of 2024, the scope of proficiency testing and training courses has been expanded to support the capacities of national laboratories in monitoring eutrophication (IMAP Common Indicators 13 & 14: inorganic nutrients in high salinity seawater, in estuarine and low salinity seawater, and chlorophyll a and Phaeopigments in Seawater) and contaminants in seafood (IMAP Common Indicator 20: heavy metals including the mandatory heavy metals – Cd, Hg, Pb, Cu, as well as additional elements such as Al, As, Co, Cr, Fe, Li, Mn, Ni, and Zn as specified for CI 17, polycyclic aromatic hydrocarbons (PAHs), dioxins, and PCBs).

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Building on elements elaborated in the Integrated Monitoring and Assessment Programme (2016 IMAP), the Monitoring Guidelines—structured around the specific technical protocols related to IMAP Common Indicator 20 were comprehensively developed by the MED POL Programme in cooperation with IAEA/MESL. These guidelines were approved by the MED POL Focal Points Meeting (2021).They build upon the knowledge and practices obtained over 40 years of MED POL monitoring implementation and recent publications, highlighting the current practices of the Contracting Parties' marine laboratories, as well as other Regional Seas Conventions and the EU. A thorough analysis of presently available practices of UNEP/MAP, UNEP and IAEA, as well the HELCOM, OSPAR and European Commission Joint Research Centre was undertaken to assist an innovative approach for preparation of the IMAP Monitoring Guidelines/Protocols. The monitoring methodologies and practices are elaborated for sampling, sample preservation and transportation, sample preparation and analysis, along with quality assurance and reporting of monitoring data, for their use by the IMAP competent laboratories in order to ensure the representativeness and accuracy of the analytical results. These guidelines present a summary of the best available known practices employed in marine monitoring by bringing integrated comprehensive analytical practices that can be applied in order to ensure the representativeness and accuracy of the analytical results needed for generation of quality assured monitoring data.

The Monitoring Guidelines for IMAP Common Indicator 20 outline the following monitoring and reporting practices (https://www.iaea.org/about/organizational-structure/department-of-nuclear-sciences-and-applications/division-of-iaea-environment-laboratories/marine-environmental-studies-laboratory/unep-map-med-pol-integrated-monitoring-and-assessment-programme-imap-monitoring-guidelines):

- D-1. Monitoring Guidelines/Protocols for Sampling and determination of contaminants in seafood
- E-1. Monitoring Guidelines/Protocols for Analytical Quality Assurance for IMAP Common Indicators 13, 14, 17, 18 and 20;
- F-1. Monitoring Guidelines/Protocols for Reporting Monitoring Data for IMAP Common Indicators 13, 14, 17, 18 and 20.

Available data sources

i. IMAP Info System (http://imapinfosystem.info-rac.org/app/#/) – one dataset reported by one Contracting Party for CI 20, and data reported for contaminants in biota (CI 17);

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ii. Recently reviewed literature, due to the absence of *in situ* data reported for CI 20, as elaborated in the CI 20 thematic assessment and the 2023 MED QSR Pollution Assessment

The two additional potential data sources:

iii. Data/reports that might be available from https://cdr.eionet.europa.eu/ (MSFD) that should be further discussed with EIONET;
iv. Data that might be available at GFCM-FAO data base for the Mediterranean Sea.

Spatial scope guidance and selection of monitoring stations

Risk-based methodologies were used as much as possible in defining the scope of monitoring for IMAP Common Indicator 20, along with establishment of national monitoring networks.

The D-1. Monitoring Guidelines/Protocols for IMAP CI 20 sets a detailed analytical procedure for sampling and determination of contaminants in seafood.

Temporal Scope guidance

Risk-based methodologies were used as much as possible in defining the scope of monitoring for IMAP Common Indicator 20, along with establishment of national monitoring networks. The temporal scope is highly linked to the data confidence and uncertainty of the indicator. Yearly statistics is the basic time period.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation – Assessment Criteria

Monitoring should allow the necessary statistical data treatments and long-term time-trend evaluations. Deriving and setting up the assessment criteria to determine environmental status is not an easy task. It gets more complicated going from the local to sub-regional and regional assessments.

The Mediterranean EAC values for Common Indicator 20, as approved by the Meeting of CorMon Pollution (27 and 30 May 2022) (UNEP/MED WG.533/10, Annex III, Appendix 1), and adopted by Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean, are presented here-below in Tables 1 to 3. They are based on the maximum regulatory levels for certain contaminants in foodstuffs as provided in EC/EU Directives 1881/2006, 1259/2011 and amendments 488/2014 and 1005/2015. The approval of the MedEAC values for CI 20 was provided further to the results of a survey undertaken by the UNEP/MAP – MED POL of the existing sources providing the actual levels of contaminants that have been detected and several contaminants that have exceeded maximum regulatory levels in commonly consumed seafood. Tables 1 to 3 show EAC CI 20 values for TM (Cd, Hg and Pb) and organic contaminants (PCBs, PAHs and dioxin).

The MedEAC values for CI 20 are in the low and mid-range of criteria used around the world and have the advantage of being consistent with the regulations of the EU. Their consistent application across the region is necessary. It should also be highlighted that these values were agreed upon at EU level also considering the ecosystem characteristics of the Mediterranean Sea. These values are taxa-specific (fish, mussel, crustacean), as well as species-specific.

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Table 1. Mediterranean EACs values for CI 20 related to trace metals as approved by the Meeting of CorMon Pollution (27 and 30 May 2022) based on the maximum regulatory levels for trace metals in foodstuffs for the protection of human health, as provided in EC/EU Directives1881/2006 and its amendments 488/2014 and 1005/2015. The concentrations are presented in mg/kg wet wt.

New EAC CI 20 for trace metals- EU 1881/2006 directive and its amendments 488/2014 and 1005/2015			
	TM, mg/kg wet wt		
Matrix	**Cd**	**Hg**	**Pb**
fish muscle	0.05-0.25	0.5-1	0.3
Cephalopods	1		1
Crustaceans	0.5	0.5	0.5
bivalve mollusk	1		1.5

Table 2. Mediterranean EAC values for IMAP CI 20 related to Benzo(a)pyrene and sum of four PAHs as approved by the Meeting of CorMon Pollution (27 and 30 May 2022) based on the maximum regulatory levels for these contaminants in foodstuffs for the protection of human health, as provided in EC/EU EC Regulations 835/2011 and 1259/2011 amending Regulation (EC) 1881/200.6. The concentrations are presented in µg/kg wet wt.

New EACs values for CI 20 related to Benzo(a)pyrene and sum of four PAHs (benzo(a)pyrene, benz(a)anthracene, benzo(b)fluorantheneand chrysene) - EC Regulation (EC) 1881/2006 and amendments 835/2011 and 1259/2011		
Matrix	**Maximum levels (µg kg^{-1} wet wt)**	
	Benzo(a) pyrene	**Sum of Benzo(a) pyrene, Benzo(a) anthracene, Benzo(a) fluoranthene and chrysene**
Smoked fish muscle	2-5	12-30
Smoked bivalve mollusc	6	35
Bivalve mollusk (fresh, chilled or frozen)	5	30

Table 3. Mediterranean EAC values for CI 20 related to Dioxins and PCBs as approved by the Meeting of CorMon Pollution (27 and 30 May 2022) based on the maximum regulatory levels for these contaminants in foodstuffs for the protection of human health, as provided in EC/EU EC Regulation 1259/2011 amending EC Regulation 1881/2006. The concentrations are presented in wet wt.

New EACs values for CI 20 related to Dioxins and PCBs – EC Regulation 1259/2011 amending EC Regulation 1881/2006			
Foodstuffs	**Maximum levels**		
	Sum of dioxins (WHO-PCDD/F-TEQ) (1) pg g^{-1} ww	**Sum of dioxins and dioxin-like PCBS (WHO-PCDD/F-PCB-TEQ) (1) pg g^{-1} ww**	**Sum of PCB28, PCB52 PCB101, PCB138, PCB1 and PCB180 (ICES 6) ng g^{-1} ww**
Fish muscle	3.5	6.5	75
Fish liver	3.5	20	200
Eel muscle	3.5	10	300

(1) Dioxins (sum of polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), express as World Health Organisation (WHO) toxic equivalent using the WHO-toxic equivalency factors (WHO-TEFs)) and st 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.).
Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish.

<table>
<tr><td>Indicator Title</td><td>Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9)</td></tr>
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Assessment of contaminants in seafood

The previous assessment of IMAP Common Indicator 20, performed during the preparation of the 2017 Mediterranean Quality Status Report (2017 MED QSR), was based on bibliographic studies and scientific documents in the Mediterranean Sea. There were no data sets reported to MEDPOL for IMAP CI 20. In the 2017 MED QSR it was concluded that " a few research studies and EU policy driven reports i.e., related to MSFD in some Mediterranean countries investigated the occurrence of contaminants in seafood from an environmental perspective i.e., the ecosystem approach, which are exceeding the maximum regulatory levels established within regulatory standards.

Due to the lack of data reported in IMAP IS, it was not possible to implement the recommendations of COP 19 regarding integrated assessments based on quality-assured data. As a result, the input for the 2023 Mediterranean Quality Status Report (2023 MED QSR), related to the initial environmental assessment of CI 20, was developed using the following two approaches:

i. The Environmental initial exemplary assessment of CI 20 based on data reported in IMAP IS for CI 17 contaminants in biota, further to the absence of in situ data reported for CI 20. CI 17 data for M. galloprovinciallis were available only for the WMS and the ADR, and CI 17 TM data for M. barbatus were available for the ADR (56 data points), CEN (15 data points) and AEL (213 data points).
ii. The Environmental Assessment of CI 20 based on recent peer reviewed literature in the absence of in situ data reported in IMAP IS for CI 20, Examination of the literature data per sub-regions was performed by counting the number of times contaminants (Cd, Hg, Pb, B(a)P) and the number of group of contaminants (Σ4 PAHs, Σ6 PCBs, PCDD/Fs and Σ (PCDD/Fs and dl PCBs)) were addressed in the literature. There were 37 entries for the WMS, 25 for the ADR, 24 for the CEN and 23 for the AEL sub-region.

Further details are provided in the thematic assessments of contaminants in seafood and the 2023 MED QSR Pollution Assessment.
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Known gaps and uncertainties in the Mediterranean

As IMAP Common Indicator 20 is the new indicator within the IMAP implementation, its applicability beyond food consumer protection and public health was necessary to determin, although intuitively reflects the health status of the marine environment in terms of their delivery of benefits (e.g. fisheries industry). Thus, monitoring protocols, risk-based approaches, analytical testing and assessment methodologies would need to be further examined between Contracting Parties national food safety authorities, research organisations and/or environmental agencies.

Further to the significant progress achieved over the last few biennia regarding the standardizing monitoring practices and progressing towards the environmental assessment tools—along with the improved availability of assessment criteria – it is essential to procced by setting a multidisciplinary approach needed to ensure GES assessment for CI 20 . By building on the achievements up to 2023, during the preparation of the 2023 MED QSR, several knowledge gaps were identified in the monitoring and assessment of Common Indicator 20, which need to be addressed following the recommendations of the 2023 MED POL Focal Points Meeting.

o A multidisciplinary approach will be essential to ensure the GES assessment for CI 20, by implementing priority actions aimed at addressing the existing gaps:Agree on the maximal percentage of detected regulated contaminants exceeding regulatory limits in seafood, above which non-GES needs to be assigned to the area assessed;
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</table>

Indicator Title	Common Indicator 20. Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood (EO9)
○ Incorporate the risk assessments to human health from consumption of seafood by calculating the estimated daily intake (EDI), the target hazard quotient (THQ), the total health risk (HI), and the cancer risk, among others; ○ Incorporate into the overall evaluation the suite of contaminants analyzed, together with other factors such as synergy among contaminants, and temporal and spatial scales. ○ Harmonize the choice of species among the CPs, whereby data from national reports on seafood safety and cooperation with national health authorities should be used to complement data reporting to IMAP IS; ○ Examine and coordinate monitoring protocols, risk-based approaches, analytical testing, and assessment methodologies between the CPs; the national food safety authorities; research organisations and/or environmental agencies; ○ Determine the applicability of CI 20 beyond food consumer protection and public health, although it intuitively reflects the health status of the marine environment in terms of delivery of benefits (e.g., fisheries industry).	

Contacts and version Date		
http://www.unepmap.org		
Version No	**Date**	**Author**
V.1	31.05.17	MED POL
V.2	12.12.18	MED POL
V.3	31/05/2019	Approved by the Meeting of MED POL FPs
Final version	09/09/2019	Approved by the 7th Meeting of EcAp Coordination Group
V4	28/05/2025	Joint CorMon Pollution and ML Meeting
V5		Approved by the Meeting of MED POL FPs
Final version		Approved by the 12th Meeting of EcAp Coordination Group

11. The revision of IMAP **Common Indicator 21 (EO9)**: "Percentage of intestinal enterococci concentration measurements within established standards" is presented in the table bellow.

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**[31]
Concentrations of intestinal enterococci are within established standards	Water quality in bathing waters and other recreational areas does not undermine human health	Increasing trend in the percentage of intestinal enterococci concentration measurements that fall in the approved GES categories as

[31] Following the decisions to be made at the present meeting regarding minor adjustments to the Targets, as outlined in working document UNEP/MED WG.624/3, the revised Targets will be incorporated into the revised IMAP Pollution Indicators Factsheets.

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)	
		established in Decision IG.20/9 and the EU 2006/7 Directive.

Rational

Justification for indicator selection

The Mediterranean Sea continues to attract every year an ever-increasing number of international and local tourists that among their activities use the sea for recreational purposes. The establishment of sewage treatment plants and the construction of submarine outfall structures have decreased the potential for microbiological pollution, despite major hotpots still exist. High levels of intestinal enterococci bacteria in recreational marine waters (coasts, beaches, tourism spots, etc) are known to be indicative of human pathogens, which is a serious public health concern, as well as economical. Therefore, intestinal enterococci concentrations are frequently used as a faecal indicator bacteria proxy or general indicators of faecal contamination in the marine environment. It has been suggested and later on demonstrated that *enterococci sp*. might be more appropriate than traditional *Escherichia coli* in marine waters as an index of faecal pollution. Currently, is the only faecal indicator bacteria recommended by the US Environmental Protection Agency (US EPA, 2012) for brackish and marine waters, since they correlate better than faecal coliforms or *E.coli*. The World Health Organization (WHO) is also in line with this approach (Ashbolt et al., 2001; Kay et al., 2004). Within the framework of Integrated Monitoring and Assessment Programme (UN/MAP IMAP) this indicator has been selected.

Scientific References

Ashbolt, N.J., Grabow, W.O.K, and Snozzi, M., 2001. Indicators of microbial water quality, Chapter 13. In: Water Quality: Guidelines, Standards and Health. 2001 World Health Organization (WHO). Edited by Lorna Fewtrell and Jamie Bartram. Published by IWA Publishing, London, UK.

Cabelli VJ, Dufour AP, Levin MA, McCabe LJ, Haberman PW. 1979. Relationship of microbial indicators to health effects at marine bathing beaches. Am. J. Public Health, 69, 690–696

Byappanahalli, MN. *et al.*, 2012. Enterococci in the environment. Microbiol. Mol. Biol.Rev., 76, 685-706

Kay, D. et al, 2004. Derivation of numerical values for the World Health Organization guidelines for recreational waters. Water Research 38 (2004) 1296–1304

Kay D, *et al.* 1994. Predicting likelihood of gastroenteritis from sea bathing: results from randomised exposure. Lancet, 344, 905–909

Prüss A. 1998. Review of epidemiological studies on health effects from exposure to recreational water. Int. J. Epidemiol., 27, 1–9

US EPA RWQC 2012. Recreational Water Quality Criteria. OFFICE OF WATER 820-F-12-058. Scientific document.

Policy Context and targets

Policy context description

The World Health Organisation (WHO) has been concerned with health aspects of the management of water resources for many years and published various documents concerning the safety of the water environment, including marine waters, and its importance for health. Revised Mediterranean guidelines for bathing water quality were formulated in 2007 based on the WHO guidelines for “Safe Recreational Water Environments” and on the EC Directive for “Bathing Waters” (EU/2006/7), and through Decision IG.20/9 (Criteria and Standards for bathing waters quality in the framework of the implementation of Article 7 of the LBS Protocol. COP17, Paris, 2012). The proposal was made in an effort to provide updated criteria and standards that can be used in the Mediterranean countries and

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)
to harmonize their legislation in order to provide homogenous data. Therefore, the standards for bathing waters quality in the framework of the implementation of Article 7 of the LBS Protocol, could be further used to define GES for the indicator on pathogens in bathing waters.	
Targets The initial target of GES under Common Indicator 21 is 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 for the "last assessment"; which means the last four years. Decision IG.20/9 on *Criteria and Standards for Bathing Water Quality*—adopted in the context of implementing Article 7 of the LBS Protocol (COP 17, Paris, 2012; UNEP/MAP, 2012)—established threshold values for bathing water quality in the Mediterranean region, as outlined in the referenced section. These threshold values were used in the preparation of the 2023 MED QSR bathing water quality assessment to define the boundary between Good Environmental Status (GES) and non-GES status in relation to pathogens in bathing waters. The assessment scale shown below was developed and applied across Mediterranean sub-regions to evaluate GES, where applicable. • A four-class assessment scale—Category A - Excellent, Category B - Good, Category C - Sufficient, category D - Poor/Immediate Action —is established in accordance with Decision IG.20/9 and the EU 2006/7 Directive. Categories A, B and C are considered to meet GES, while Category D is classified as non-GES for intestinal enterococci (IE) in Mediterranean bathing waters. • A threshold value for the GES / non-GES boundary is defined. The decision rule for GES/non-GES status is based on comparing assessment score values against the boundary limit value defined for Category D. • Bathing water classification is based on the 90^{th} or 95^{th} percentile of the log10 normal probability density function of microbiological data. Each location must have at least 16 data points collected over four bathing seasons, with a minimum of four samples per season with the interval between samplings does not exceed one month (exceptions are outlined in Directive 2006/7/EC and Decision IG.20/9).	
Policy documents **General Policy documents** Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9). Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28). Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9). Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28). Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027. Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria. Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.	

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)

Decision IG.24/4 (COP21, 2019) on Assessment Studies.

Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (EU Marine Strategy Framework Directive and updates in 2010).

Commission Directive (EU) 2017/845 amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies

Commission Decision (EU) 2017/848 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (and updated revisions).

Commission Decision (EC) No 2013/480/EU establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise and repealing Decision 2008/915/EC.

2017 Mediterranean Quality Status Report, https://www.medqsr.org/node/10/

2023 Mediterranean Quality Status Report, medqsr2023.info-rac.org

UNEP(DEPI)/MED IG.22/Inf.7. (2016) Integrated Monitoring and Assessment Guidance

Bathing Waters related Policy documents

Decision IG.20/9. Criteria and Standards for Bathing Waters Quality in the framework of the implementation of Article 7 of the LBS Protocol. (COP17, Paris, 2012.

Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC

(http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006L0007&from=EN)

UNE/MAP MED POL, 2010. Assessment of the state of microbial pollution in the Mediterranean Sea. MAP Technical Reports Series No. 170 (Amended).

UNEP/MED WG.556/Inf.13/Rev.1. (2023), The Marine Environment Assessment in the Areas with Insufficient Data: The Results of Assessment for IMAP Common Indicator 21 in the Mediterranean.

Indicator analysis methods

Indicator Definition

The concentration (Colony-forming unit, CFU) of intestinal enterococci in the water sample (normalised to 100 mL) collected at one beach location.

Methodology for indicator calculation

For the indicator calculation, the methodology was set by Directive 2006/7/EC with the specification outlined below:

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)

Based upon percentile evaluation of the log10 normal probability density function of microbiological data acquired from the particular bathing water, the 90th and 95th percentile values are derived as follows:

1) 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)

2) Calculate the arithmetic mean of the log10 values (μ).

3) Calculate the standard deviation of the log10 values (σ).

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). 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).

Indicator units

The 90th and 95th percentiles of the log10 normal probability density function of the CFU datasets measured at one single location according established monitoring and assessment protocols and standards.

List of Guidance documents and protocols available

ISO 7899-1[Water quality – Detection and enumeration of intestinal enterococci: Part 1: Miniaturized method (Most Probable Number) for surface and wastewater]

ISO 7899-2 [Water quality – Detection and enumeration of intestinal enterococci: Part 2: Membrane filtration method].

WHO Guidelines for Safe Recreational Water Environments. Volume 1: Coastal and fresh waters, 2003.

WHO Guidelines for Safe Recreational Water Environments Recreational Water Environments. Volume 2: Swimming Pools and Similar Environments, 2006.

Revised Mediterranean guidelines for bathing waters based on the WHO guidelines for Safe Recreational Water Environments and on the EC Directive for Bathing Waters" (EU/2006/7), and Decision IG.20/9 on Criteria and Standards for Bathing Water Quality in the framework of the implementation of Article 7 of the LBS Protocol, 2007.

European Environment Agency (EEA). European Topic Centre on Inland, Coastal and Marine Waters, 2021.

Data Confidence and uncertainties

As in the case of analytical chemistry, the data confidence originates in the maintenance of internal QA/QC programmes by national laboratories, as well as regular interlaboratory or proficiency testing exercises. It should be mentioned that the level of uncertainty in measurements could be considered low, provided the above is fulfilled. On the other hand, the ISO 7899-2 methodology describes the isolation of intestinal enterococci (*Enterococcus faecalis, E. faecium, E. durans*and *E. hirae*), pointing out that, other Enterococcus species and some species of the genus Streptococcus (namely *S. bovis*and *S. equinus*) may occasionally be detected. These Streptococcus species do not survive long in water and are probably not enumerated quantitatively. Further, for purposes of water examination, *enterococci sp.* can be regarded as indicators of faecal pollution, despite it should be mentioned that some enterococci found in water can occasionally also originate from other habitats.

Methodology for monitoring, temporal and spatial scope

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)

Available Methodologies for Monitoring and Monitoring Protocols

Revised Mediterranean guidelines for bathing waters were formulated in 2007 based on the WHO guidelines for "Safe Recreational Water Environments" and on the EC Directive for "Bathing Waters" (EU/2006/7), and through Decision IG.20/9 on Criteria and Standards for Bathing Water Quality in the framework of the implementation of Article 7 of the LBS Protocol (COP17, Paris, 2012). The proposal 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.

Available data sources

i. IMAP Info System (http://imapinfosystem.info-rac.org/app/#/);
ii. The European Environment Agency (EEA) (https://www.eea.europa.eu/data-and-maps/indicators/bathing-water-quality; https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/state-of-bathing-water/state-of-bathing-waters-in-2020).

Spatial scope guidance and selection of monitoring stations

Sampling should be performed in recreational waters where microbiological pollution could threat the recreational uses. The measurements are made in selected monitoring stations during the bathing seasons and other sites of concern. The full description of indications to prepare a monitoring strategy is outlined in Directive 2006/7/EC concerning the management of bathing water quality.

Temporal Scope guidance

According to EU Directive 2006/7EC (Annex IV) and Decision IG.20/9, the temporal scope guidance is as follows:

1. One sample is to be taken shortly before the start of each bathing season. Taking account of this extra sample and subject to paragraph 2 (below), no fewer than four samples are to be taken and analysed per bathing season.
2. However, only three samples need be taken and analysed per bathing season, as detailed in the below section on the assessment, in the case of a bathing water that either:
(a) has a bathing season not exceeding eight weeks; or
(b) is situated in a region subject to special geographical constraints.
3. Sampling dates are to be distributed throughout the bathing season, with the interval between sampling dates never exceeding one month.
4. In the event of short-term pollution, one additional sample is to be taken to confirm that the incident has ended. This sample is not to be part of the set of bathing water quality data. If necessary to replace a disregarded sample, an additional sample is to be taken seven days after the end of the short-term pollution.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation – Assessment Criteria

Decision IG.20/9 on *Criteria and Standards for Bathing Water Quality*—adopted in the context of implementing Article 7 of the LBS Protocol (COP 17, Paris, 2012)— agreed on the threshold values in the Mediterranean region as presented in below table.

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**

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)

Limit values	<100*	101-200*	185**	>185**(1)
Water Quality	Excellent	Good	Sufficient	Poor/Immediate Action

*Based on the 95th percentile; ** Based on the 90th percentile;

- (1) For single sample appropriate action is recommended to be carried out once the
- count for IE exceeds 500 cfu/100 mL:
- For classification purposes at least 12 sample results are needed spread over 3-4 bathing seasons; Exceptions related to the assessment of monitoring data are outlined in Directive 2006/7/EC and Decision IG.20/9, as detailed in the following section on assessment outputs.
- 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).

Monitoring should allow the necessary statistical data treatments, as well as time-trend evaluations. While considering the IMAP nested for presentation of the assessment findings, the balance between data, locations and spatial resolution should be carefully considered for coherence in areas, as CI 21 is assessed in coastal waters

Assessment of Bathing Water Quality For pathogenic microorganisms in bathing water, monitoring for the assessment of GES could be carried out on a sub-regional and/or local level due to the nature of microbiological contamination (the impact is restricted to a relatively short distance from the pollution source due to the short survival time of microorganisms in seawater and dilution effects).Distribution maps and short-term temporal trend assessments should also be utilized.

Due to insufficient data reported in the IMAP Information System (IMAP IS), the full implementation of the COP 19 recommendations on integrated assessments based on quality-assured data was not possible. Consequently, the input related to the environmental assessment of Common Indicator 21 (CI 21) for the 2023 Mediterranean Quality Status Report (2023 MED QSR) was developed upgrading the approach applied in the 2017 MED QSR. This approach combined assessment results from nine Contracting Parties, as presented in the EEA 2020 State of Bathing Water Quality report (https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/state-of-bathing-water/state-of-bathing-waters-in-2020), with the evaluation of monitoring data reported for CI 21 in IMAP Info System by five Contracting Parties.

The methodology used in the EEA's 2020 assessment of bathing water quality followed the EEA Guidelines for assessments under the Bathing Water Directive. This approach is consistent with the requirements of Directive 2006/7/EC and IMAP Decision IG.20/9. Specifically, bathing waters were classified based on the 90th or 95th percentile values derived from the log10 normal probability density function of microbiological data. Each monitoring location included a minimum of 16 samples collected over four bathing seasons, with at least four samples per season.

Exceptions to this standard are outlined in Directive 2006/7/EC and Decision IG.20/9. In brief, assessments may be conducted using data from three bathing seasons if the bathing water is newly designated or if significant changes have occurred that could affect its classification. The dataset must still include at least 16 samples in such cases. Under special circumstances—such as when the bathing season lasts no longer than eight weeks or when the site is located in a region with particular geographical constraints—only 12 samples may be used (as stipulated in Annex IV, paragraph 2 of the Directive).

The Directive defines two key microbiological indicators: *Intestinal enterococci* (IE) and *Escherichia coli* (E. coli), both measured in colony-forming units per 100 ml (cfu/100 ml). The final classification of bathing waters is determined by the lower status of the two indicators. For instance, if the water quality for IE is classified as "excellent" but the E. coli level is "poor," the overall classification for the site is "poor."

Indicator Title	Common Indicator 21. Percentage of intestinal enterococci concentration measurements within established standards (EO9)

The same methodology used in the EEA 2020 assessment of bathing water quality was applied to the dataset reported in the IMAP Info System by three Contracting Parties, using intestinal enterococci as the sole indicator. However, this methodology could not be applied to data from two other Contracting Parties, as the required 16 data points over four consecutive bathing seasons were not available. For these two Contracting Parties, classification was instead based on the geometric mean calculated for each location. The geometric mean was chosen because it minimizes the impact of outliers and is less affected by skewed data distributions compared to the arithmetic mean.

The table below compares the two methodologies.

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

Further details are provided in the thematic bathing waters assessments and the 2023 MED QSR Pollution Assessment.

Known gaps and uncertainties in the Mediterranean

Building on the significant progress made over recent biennia in standardizing monitoring practices and advancing environmental assessment tools, it is essential to ensure a robust Good Environmental Status (GES) assessment for Common Indicator 21 (CI 21). This requires strengthening data reporting to enhance the reliability and confidence of the assessment. To apply the uniform assessment methodology consistently across the Mediterranean, a minimum of 16 data points over four consecutive bathing seasons is required. This will significantly improve the comparability and consistency of the assessment findings.

Contacts and version Date

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Version No	**Date**	**Author**
V.1	31.05.17	MED POL
V.2	12.12.18	MED POL
V.3	29.04.19	MED POL
Final version	31/05/2019	Approved by the Meeting of MED POL FPs
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V5		Approved by the Meeting of MED POL FPs
Final version		Approved by the 12th Meeting of EcAp Coordination Group

Appendix 5
Updated Guidance Factsheets for IMAP Candidate Common Indicators 26 and 27

Table of Contents

1. Introduction

1. This document presents the revised Guidance Factsheets for IMAP Candidate Common Indicators 26 and 27 in accordance with Decision IG.26/3 (COP 23, 2023) concerning the 2023 Mediterranean Quality Status Report (MED QSR) and the Renewed Ecosystem Approach Policy in the Mediterranean.

2. The current revision builds upon achievements endorsed for the preparation of the 2023 Mediterranean Quality Status report (2023 MED QSR) by the 2023 Meetings of MED POL Focal Points and the Integrated Ecosystem Approach Correspondence Group. It also responds to the request of 2019 Meeting of MED POL Focal Points for further elaboration of IMAP Guidance Factsheets for IMAP Candidate Common Indicators 26 and 27 to incorporate evolving scientific knowledge.

3. These foundational achievements determining the revision of the IMAP Guidance Factsheets for Candidate Common Indicators 26 (impulsive noise) and 27 (continuous noise) include:

a) Development, Testing, and Implementation of Initial GES Assessment Methodologies for Impulsive and Continuous Noise

i. Assessment methodologies were established for evaluating IMAP Candidate Common Indicators 26 and 27 within the preparation of the 2023 Mediterranean Quality Status Report (MED QSR). These methodologies were developed based on the work of the EU Technical Group on Underwater Noise, with contributions from ACCOBAMS and UNEP/MAP-SPA/RAC.

ii. Specifically, the assessment methodology applied in the 2023 MED QSR and included in the IMAP Guidance Factsheets indicates:

- For IMAP Candidate Common Indicator 26, threshold levels should be applied to the percentage of habitat occupied by noise-sensitive species affected by impulsive noise events, following a risk-based approach.
- For IMAP Candidate Common Indicator 27, a single threshold should be applied to the percentage of habitat of noise-sensitive species affected by continuous noise.

b) Strengthening Assessment Criteria, including:

i. Establishment of threshold values to maintain Good Environmental Status (GES) for both short-term and long-term exposure to impulsive noise events.

ii. Definition of a single threshold to maintain GES for exposure to continuous noise events.

iii. Classification of GES and non-GES status based on the application of these thresholds in noise assessments.

iv. Updating of statistical analyses and temporal scopes to support assessment methodologies for IMAP Candidate Common Indicators 26 and 27.

c) Incorporation of New Scientific and Policy Developments

Advancements since 2019 have been integrated to support the aforementioned achievements in IMAP noise assessments, as requested by the 2019 Meeting of MED POL Focal Points.

2. Guidance Factsheet on IMAP Candidate Common Indicators 26 and 27

4. The revision of IMAP **Candidate Common Indicator 26 (EO11)**: "Proportion of days and geographical distribution where loud, low and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animals", is presented in the table bellow.

Indicator Title	Candidate Common indicator 26: Proportion of days and geographical distribution where loud, low and mid-frequency impulsive sounds exceed levels that are likely to entail significant impact on marine animals	
Relevant GES definition[1]	**Related Operational Objective**	**Proposed Target(s)**[2]
Noise from human activities causes no significant impact on marine and coastal ecosystems	Energy inputs into the marine environment, especially noise from human activities, are minimized	State: The extent (%) of habitat of noise-sensitive species within the assessment area that is impacted by impulsive noise events is below thresholds.
Rationale		

Justification for indicator selection

Anthropogenic energy introduced by human activities into the marine environment includes sound, light and other electromagnetic fields, heat and radioactive energy. The most widespread and pervasive is underwater sound (Dekeling et al., 2014). Sound energy input can occur at varying spatial and temporal scales. Anthropogenic sounds may be of short duration (i.e. impulsive) or be long lasting (i.e. continuous). Lower frequency sounds can be transmitted far (tens to thousands of kilometres), whereas higher frequency sounds transmit less well in the marine environment (hundreds of meters to few kilometres (Urick, 1996). Most common sources of marine noise pollution in the Mediterranean Sea include ship traffic, geophysical exploration and oil and gas exploitation, military and civil sonar use and underwater detonations, scientific research involving the use of active acoustic sources, and offshore and inshore industrial construction works (ACCOBAMS 2016; ACCOBAMS al., 2022).

Marine organisms can be adversely affected both on short and long timescales (and include acute or chronic impact and temporary or permanent effects (Richardson et al, 1995). Adverse effects can be subtle (e.g. temporary reduction in hearing sensitivity, stress effects causing reduced immunity, reproduction success or survival), or more obvious (e.g. injury, death). The former may be difficult to observe and evaluate while the latter may in some circumstances be related to acute short-range noise exposures. There is a robust base of scientific evidence with regards to the effects of underwater impulsive noise on marine fauna, and especially cetaceans. Cetaceans' reliance on sound for communication, foraging, mating, and navigation makes them ideal indicators of acoustic disturbance. It has been demonstrated indeed those naval exercises involving the use of mid-frequency active sonars that are related to mass stranding events of cetaceans and especially Cuvier's beaked whales. Furthermore, geophysical surveys, pile driving and other loud impulsive noise signals have been correlated to a wide range of negative behavioural and physiological effects in fin whales and other baleen whales, sperm whales, different species of beaked whales, pilot whales and more. (e.g.: Benhemma-Le Gall et al., 2021; Blackwell et al., 2015; Borsani et al., 2008; Carroll et al., 2017; Castellote et al., 2012; Deruiter et al., 2013; Filadelfo et al., 2009; Frantzis, 1998; Goldbogen et al., 2013; Gomez et al., 2016; Isojunno et al., 2020; Parsons,

[1] Following the decisions to be made at the present meeting regarding the GES definition and minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3/Rev.1, the revised Targets and GES definition will be incorporated into the revised IMAP Pollution Indicators Factsheets.

[2] ibidem

2017; Sciacca et al., 2016; Southall et al., 2013, 2019; Tougaard et al., 2013; Tyack & Thomas, 2019; Weir, 2008).

Management concern is primarily associated to the negative effects of noise on sensitive protected species, such as some species of marine mammals.

Scientific References

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Policy Context and Targets

Policy context description

Generalities:

In the marine environment, the term pollution is defined in several legal frameworks by the following statement: “the introduction by man, directly or indirectly, of substances or energy into the marine environment […]”. This definition includes anthropogenic noise as a form energy caused by human activities. As such, underwater noise pollution is addressed by Regional Seas Conventions, where the following initiatives are considered the most relevant for the management of activities generating noise, and the mitigation of their adverse effects on the marine environment:

1. For the Barcelona Convention, the Ecosystem Approach process (EcAp), started in 2008;
2. For the OSPAR and HELCOM Conventions, the adoption for their respective monitoring and assessment processes of the indicators related to underwater noise as proposed in the framework of the MSFD (2011 and 2012).

In parallel, the European Union adopted the same definition of pollution given in the paragraph above in the Marine Strategy Framework Directive (MSFD, 2008/56/EC, adopted in 2008).

With regards to the MSFD, underwater noise is addressed by Descriptor 11, and two criteria were selected for monitoring and assessment purposes, one addressing loud impulsive signals produced by several coastal and offshore works (pile driving, explosions, seismic pulses, etc.), the other targeting the contribution of anthropogenic sources, especially shipping, to ambient noise levels. Since the adoption of the MSFD (2008), the European Commission issued two Decisions addressing methodological standards for the monitoring and assessment of underwater noise: Commission Decision 2010/477/EU on criteria and methodological standards on good environmental status of marine waters, and Commission Decision 2017/848/EU laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Concerning the EcAp process, among the eleven IMAP Ecological Objectives (EOs), and respective operational objectives and indicators agreed through Decision 20/4 (COP 17, Paris, 2012), EO11 addresses underwater noise produced by human activities. However, Decision 21/3 ((COP18, Istanbul, 2013) provided a specific list of descriptions of good environmental status and targets for the other EOs, contrary to EO11, considered not yet sufficiently understood to allow a proper definition of good environmental status.

Therefore, in the period 2014-2015 ACCOBAMS in cooperation with the UNEP/MAP Secretariat developed the “Basin-wide Strategy for underwater noise monitoring in the Mediterranean” thanks to its working group on noise (Joint ASCOBANS/ACCOBAMS/CMS Noise Working Group). This strategy proposed to address two types of noise for the monitoring and assessment purposes, as for the MSFD process: loud impulsive signals produced by coastal and offshore works (especially pile driving, explosions, seismic pulses and sonar), and the contribution of anthropogenic sources, especially shipping, to ambient noise levels. The strategy was included in the Integrated Monitoring and Assessment Programme (IMAP) by the Integrated CORMON Meeting i (Athens, 30 March– 1 April , 2015), which was finally adopted during the COP19 (Athens, 2016). Also, the COP19 assigned to ACCOBAMS the issues related to underwater noise based on the Memorandum of Understanding signed between ACCOBAMS and UNEP/MAP with the aim of strengthening the cooperation between the two organisations to move forward with the implementation of EO11.

After 2016, several initiatives have been undertaken by ACCOBAMS, including the participation to European projects (QUIETMED in the period 2017-2018, QUIETMED-2 in the period 2019-2020, and QUIETSEAS in the period 2021-2022), the execution of dedicated studies, the implementation of monitoring programs, the contribution to the development of technical guidance relative to both EcAp and the EU-MSFD, and finally the coordination of the first basin-wide assessment of underwater noise pollution relative to EO11 under the scope of the 2023 Mediterranean Quality Status Report, (2022-2023).

Several other legal frameworks have addressed anthropogenic underwater noise and its impact on the marine environment and wildlife: The International Whaling Commission (IWC), the Convention on Biological Diversity (CBD), the Convention on Migratory Species (CMS), ASCOBANS, and more. Almost all the initiatives undertaken by such legal frameworks deal with the impact of noise on some environmental element (usually sensitive marine fauna such as cetaceans and fish, turtles, crustaceans, etc.), and mitigation measures related to single industrial activities. The novelty of the MSFD and EcAp processes is that the emphasis is put on the status of the ecosystem and hence on the cumulative impact of all human activities occurring in the maritime space.

With specific regards to impulsive noise:

In EU Member States, human activities producing loud impulsive signals into the marine environment are managed nationally through licensing systems, and the consideration of the impact of noise in such management processes is especially due to the European Directive on the Environmental Impact Assessment (EIA Directive). However, the EIA Directive is “project-based”, contrarily to the MSFD and EcAp, which are “ecosystem-based”. The main difference between project-based and ecosystem-based approach is that in the case of an EIA, the project developer (e.g. an industry) is responsible for assessing and mitigating the impact of its own activities, while in the case of the EcAp and MSFD processes, countries’ governments are responsible for the achievement and/or maintenance of the good environmental status, which include addressing and managing the potential adverse impact of all pressures in the marine environment.

The transposition in national legislation of the EIA Directive resulted in different national management systems. For instance, in the UK a standard mitigation framework applies to a list of well-defined
activities; in Germany, impulsive sound signals are allowed as far as they do not exceed legal thresholds (a certain received noise level at 750 m from the source); in Italy the project developer need to implement 60 days monitoring before and after the activity to understand whether or not the activity caused any impact.

Again, while the EIA Directive gave considerable results in managing the impact of single activities introducing noise into the sea, a framework addressing the ecosystem scale has been in need of development in the past decades. This Factsheet addresses exactly this point and provides the required methodological elements for the monitoring and assessment of underwater impulsive noise and hence the implementation of the ecosystem approach to the management of activities producing impulsive noise.

Targets

The primary activity under IMAP Candidate Common Indicator 26 should be the setting up by country of a database (“a noise register[3]”) for the registration of “noise events”, where a noise event is the occurrence of loud impulsive signals (in low and mid frequency bands) on a given day and in a given

[3] See for example: http://underwaternoise.ices.dk/map.aspx ; https://quietseas.ctnaval.com/

place. Once the register is built, it is possible to obtain an overview of the spatial and temporal distribution of noise-producing activities. Furthermore, by including information about the habitat of noise-sensitive species, it is possible to move towards the assessment of whether the risk of the negative impacts occurring on populations of such species is acceptable. Therefore, a threshold system was tested to define the acceptable risk level related to the occurrence of impulsive noise events within the 2023 MED QSR.

The initial threshold system is based on the impulsive noise assessment methodology outlined in the 2023 MED QSR which was accepted by the Integrated Meeting of the Ecosystem Approach Correspondence Groups (27-28 June 2023, Athens, Greece) and the Meeting of the MAP Focal Points (12-15 September 2023, Istanbul, Türkiye). The MED QSR 2023 impulsive noise methodology is in turn based on previous activities carried out by ACCOBAMS and UNEP/MAP - SPA/RAC under the QUIETMED and QUIETSEAS projects (Azzellino et al., 2021; Maglio et al., 2020; Maglio, Frey, et al., 2018) as well as by the European Commission technical group on underwater noise (Sigray et al., 2023).

The thresholds are applied to the % of habitat of noise-sensitive species which is affected by impulsive noise events. To achieve or maintain the Good Environmental Status, the following thresholds should be applied as follows:

3. **For short-term exposure (1 day, i.e., daily exposure)**, the maximum proportion of a habitat area utilized by a species of interest that is accepted to be exposed to impulsive noise levels higher than the Level of Onset of Biological Effects (LOBE)[4], over 1 day, is 20% or lower (≤20%).
4. **For long-term exposure (1 year)**, the average exposure is calculated. The maximum proportion of a habitat area (calculated as the mean of the daily proportions over one year) utilized by a species of interest that is accepted to be exposed to impulsive noise levels higher than LOBE, over 1 year on average, is 10% or lower (≤10%).
5. These threshold values were used for the initial impulsive noise assessment within the 2023 Mediterranean Quality Status Report ,

The thresholds are given as a range (X% or lower) in order to take regional and sub-regional specificities into account. According to the setup and purposes of the assessment, a single thresholds value is picked up within the given ranges. Hence, threshold levels lower than 10% and 20% can be set according to local or regional specificities.

Policy documents

ACCOBAMS Resolution 7.13 - Anthropogenic Noise. ACCOBAMS-MOP7/2019/Doc38/Annex15/Res.7.13. 2019

ACCOBAMS Resolution 8.17 - Anthropogenic Noise. ACCOBAMS-MOP7/2019/Doc38/Annex15/Res.7.13. 2023

Commission Decision 2017/848/EU of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision (2010/477/EU)

Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment; and successive amendments in 1997 (97/11/EC), 2003 (2003/35/EC), and 2009 (2009/31/EC). This Directive was repealed and replaced by the following:

[4] The LOBE level, meaning Level of Onset of Biological Effect, is expressed in suitable sound metrics (e.g., sound pressure level or sound exposure level) and should be defined under the guidance of national and/or regional expert groups.

Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment; also amended in 2014 (2014/52/EU). Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9). Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28). Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027. Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria. Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report. Decision IG.24/4 (COP21, 2019) on Assessment Studies. Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
Indicator analysis methods

Indicator Definition The indicator is defined by the number of days and the spatial extent with impulsive sound sources in an assessment area and over a defined period. Such areas may be the cells of a spatial grid, or larger scale areas such as the subdivision, the sub-regional and the whole region . Not all impulsive noise sources are to be accounted for, only those exceeding minimum levels are considered to have a significant impact on populations of sensitive wildlife. The impact is considered significant when severe displacement of animals from their habitats occurs due to noise. Noise levels inducing the onset of significant impact are defined in the “Basin-wide Strategy for Underwater Noise Monitoring in the Mediterranean” (ACCOBAMS, 2015) and are still considered valid. The values as provided in this document need to be used to decide whether new noise event should or not be registered in the noise register. This definition was applied for the initial impulsive noise assessment in the 2023 MED QSR . It concerns the quantities considered for monitoring the pressure on the marine environment from underwater impulsive noise.
Methodology for indicator calculation The calculation is given by: The geographical extent of the occurrence of noise events, and the sum of all non-overlapping days of such noise events, over a defined period (one year or temporal window such as month or trimester), and for an assessment unit (for example a grid cell in a spatial grid, a sub-division, sub-region, region). A spatial grid with a regular cell size is proposed to compute the number of days with impulsive sound sources. The calculation is done for each grid cell using common GIS software or more sophisticated web applications. Also, the calculation may be done in single assessment units or per sub-regions, region, or subdivisions decided at the country level. The “Basin-wide Strategy for Underwater Noise Monitoring in the Mediterranean” (ACCOBAMS, 2015) proposed to use of a 20x20 km spatial grid. However, recent developments (especially the

results of the QUIETMED project) led to the proposal of different options, including: the spatial grid already used by the General Fisheries Commission for the Mediterranean (GFCM statistical rectangles), which has a dimension of 30 min in latitude and longitude, or the adoption for all noise sources of spatial grids already used by countries to manage human activities nationally (e.g. Oil&Gas licenced areas).
Indicator units <u>For the spatial aspect</u>: 1. The daily proportion of the assessment area (%) which is covered by noise events, taking the sum of the area of each grid cell considered as impacted by noise events 2. The average proportion (%) over 1 year, i.e., the sum of all the daily proportions divided by 365(6) <u>For the temporal aspect</u>: The sum of all non-overlapping days of occurrence of impulsive noise events in a unit area and in a given period[5].
List of Guidance documents and protocols available A basin-wide strategy for underwater noise monitoring in the Mediterranean. Report prepared by Alessio Maglio, Manuel Castellote and Gianni Pavan. (ACCOBAMS, 2015) End Report on GES criteria assessment at basin scale with focus on the consistency and coherence of approaches at national levels (including operational targets definition) - Deliverable 2.3 (Maglio, Frey, et al., 2018) Joint proposal of a methodology to establish thresholds for impulsive noise in the Mediterranean Sea Region. QUITEMED2 D5.1. GA No. 110661/2018/794481/SUB/ENV.C2, (2021) -63pp (Azzellino et al., 2021) Methodological framework for regional and sub- regional risk-based assessment for impulsive noise in the Mediterranean region. *QUIETMED2 – D4.1.* (Maglio et al., 2020) Monitoring Guidance for Underwater Noise in European Seas, Part II: Monitoring Guidance Specifications, JRC Scientific and Policy Report EUR 26555 EN, Publications Office of the European Union, Luxembourg, 2014b, doi: 10.2788/27158. (Dekeling et al., 2014) Recommendations to Member States to set up the national registers of impulsive noise according to criterion D11C1 of the Commission Decision 2017/848/EU and ACCOBAMS premises, and generalisation for the EcAp process. Deliverable 3.4, QUIETMED project. (Maglio, Salivas, et al., 2018) Setting EU Threshold Values for impulsive underwater sound Technical Group on Underwater Noise (TG NOISE) MSFD Common Implementation Strategy. https://doi.org/10.2760/60215 (Sigray et al., 2023).
Data Confidence and uncertainties Data confidence is expected to be high due to the simplicity of the data themselves. To meet minimum objectives of Candidate Common Indicator 26 monitoring, only the location (geographical coordinates or area), the period (dates) and intensity of noise sources used are necessary. All such information, including the intensity of the noise source, should be obtained from declarative data, *i.e.* it is not necessary to measure the real noise level with any equipment, or to carry out fieldwork to locate noise-producing activities.

[5] This definition was formerly called ***pulse-block days*** (PBDs).

Declarative data can be sought in the national institutes already centralising data on marine activities (e.g. institutions managing Oil & Gas licensing procedures; or environmental impact assessment procedures; etc.). This system, on the one hand result in very low costs for obtaining data, while in the other hand add some uncertainty.

Uncertainty is mainly due to the fact that declarative data may not be available (e.g. sensitive data such as data on military activities), not well specified or with important gaps, or not completely suitable for impulsive noise monitoring as described in this Factsheet.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Monitoring Methodology: A register of the use of noise sources is the necessary tool enabling a monitoring programme. The register is a database fed with data on the use of underwater noise sources (noise events).

Tools for impulsive noise sources monitoring (i.e. tool for setting the noise register): the joint use of a spreadsheet (MS Excel or similar) and common GIS software is considered as the recommendation to meet the minimum requirements of Candidate Common Indicator 26, where the spreadsheet is used to record noise events, and the GIS software to perform spatial analysis of these areas (e.g. to compute the number of pulse-block days).

What noise sources should be registered:

Pile driving. Pile driving is a conventional technique employed in many coastal and offshore constructions, such as wind farms, offshore platforms, harbour extensions etc. The growth of the wind energy sector caused a great increase in the use of this technique both in coastal and offshore environments.
Airgun. The airgun is presently the most employed technology for carrying out marine seismic exploration. Such surveys are pervasive worldwide, in shallow and deep water as well as in coastal or offshore environments

Explosives. Underwater detonations may occur for the disposal of explosives or may be planned during maritime construction, e.g. to fragment rock prior to dredging. This is the loudest source of underwater noise and need to be treated with particular care.

Sonar. Low-, mid- and high frequency active sonars (LFAS, MFAS, HFAS) are employed during military exercises as well as during academic and industrial surveys, such as fish stock estimations and bathymetric surveys. Especially, low- and mid- frequency naval sonars are of great concern given the mass stranding events of cetaceans linked in space and time with military exercises and need to be addressed with particular care.

Acoustic Deterrents. High-powered devices designed to keep marine mammals away from fish farms by causing them pain. Frequencies range from 5-20KHz for repelling pinnipeds and 30-160KHz for delphinids (Carretta et al, 2008, Lepper et al, 2004, Lurton, 2010, OSPAR, 2009).

What information to collect to be entered into the register:

Data	**Units and/or comments**	**Priority**
Position	Geographic position (lat/long) or pre-defined block/area which can be identified through a coding system (single identifier for each block used)	Required
Dates	Start and end day	Required
Source intensity	Source level or proxy, unique levels or in bins (see Annex 5.3 for corresponding tables of values in bins)	Required
Source spectra	Frequency range	Additional

Duty cycle		Additional
Duration of transmission	Actual time/time period	Additional
Directivity		Additional
Source depth		Additional
Platform speed	For moving sources like seismic surveys	Additional

Minimum levels (Source intensity) for including a noise event in the register:

6. For low frequency sources: no minimum level, i.e. all sources to be registered
7. For mid-frequency sources, table hereafter:

Noise source type	Thresholds for inclusion of noise events in the register
Explosive	mTNTeq > 8 g
Airgun	SLz-p > 209 dB re 1 µPa m
Low/mid freq sonar	176 dB re 1 µPa m
Low/mid freq acoustic deterrent	176 dB re 1 µPa m
Other pulse	186 dB re 1 µPa² m² s

Again, **there is no need to measure on the field** and data are to be sought in institutions centralising data (Ministries, national regulatory bodies, but also industries, etc.).

Monitoring Protocol: Data on the use of impulsive noise sources (location, period, and intensity at least) are entered in the register on a regular basis (once, twice or more times per year). This is done by a selected contact person in each country.

Available data sources

ACCOBAMS Noise Register (https://quietseas.ctnaval.com/)

National data repositories available for some countries for specific activities (e.g. licensing areas for seismic exploration). Some examples:
http://www.minetur.gob.es
http://www.ifremer.fr/sismer
http://bo.ismar.cnr.it
http://unmig.mise.gov.it/;
http://unmig.sviluppoeconomico.gov.it
~~http://energy.gov.il~~ Environmental Information Ministry of Energy and Infrastructure
http://www.sigetap.tn
http://www.ypeka.gr
http://www.beph.net

Second Hotspots Report: updated overview of the noise hotspots in the ACCOBAMS Agreement area. ACCOBAMS-MOP8/2022/Inf43. EIGHTH MEETING OF THE PARTIES TO ACCOBAMS, Malta, 29 November – 2 December 2022. (Muller et al., 2022)

Further data repositories are open data platform developed by different organisations, where the most relevant appear to be: EMODnet (EU funded platform https://emodnet.ec.europa.eu/en). From EMODnet it is possible to access data gates for marine human activities, including marine renewable energy plants, platforms, cables, dredging and others.

For military activities, as a first approach, the *notice to mariners*[6] can be monitored to gather information on possible military activities (military areas information is also included in EMODnet). Notice to mariners are indeed freely available information for navigation.
Spatial scope guidance and selection of monitoring stations No monitoring stations are needed, only declarative data are required to fill up the noise register. Concerning the spatial scope at large: the monitoring methodology is based on the use of a regular spatial grid to compute days with noise events per unit area, where unit area may be, for example, a cell of the regular spatial grid. If a noise event lasts several days in the same unit area), the number of days is equal to the duration (in days) of that noise event.
Temporal Scope guidance Data on noise events can be entered in the register by the responsible institution several times in a year, for example whenever data become available.
Data analysis and assessment outputs
Statistical analysis and basis for aggregation Basic descriptive statistics are needed to compute the indicator (Cf Indicator units, above): 1. the number of days with noise events over a time window; 2. the % of an assessment area with impulsive sound sources. The basis for aggregation is the national Noise Register. From a regional and sub regional perspective, once the noise register is established by all countries, such data may be transferred to the ACCOBAMS Noise Register. This is proposed as the basis for regional and sub regional aggregation of data which can feed regional assessment (e.g., the MED QSR) as well as supporting countries in reporting data related to EcAp EO11. With regards to data analysis for the assessment of the environmental status of a maritime area, the methodology applied for the initial assessment within the 2023 MED QSR needs to be considered. The indicator needs to be combined with information concerning the habitat of noise sensitive-species, in order to calculate the proportion of such habitat which is affected by impulsive noise. Using the entries in the noise register, the time steps are counted in the unit of days. In total 365 (366) evaluations are done corresponding to one assessment per day per calendar year. Notable, is that the evaluation can be limited to months, years, seasons, or sensitive times, but always based on days. - The first step is to determine the proportion of the assessment area which is exposed to levels higher than the Level of Onset of Biological Effects (LOBE). This is done for every day of the year. This will result in an exposure map for the whole area covered by the registry. - The next step is to determine the extent of the habitat of selected noise-sensitive species in the assessment area ($A_{Habitat}$). This can be done by applying different methods, including refined habitat modelling and/or other GIS analyses. This part should be addressed consistently with relevant indicators of EO1 (Biodiversity). - The next step is to determine the extent of the habitat which is exposed to noise higher than LOBE (A_{LOBE}).

[6] Notice to mariners are information issued by country's military authorities. Such notices inform on sailing in a given area about the occurrence of some military exercise or other activity that may be dangerous for boats sailing in the area. For example, notice to mariners may be used for collecting data about military activities to be included in the noise register

- Dividing the exposed part of the habitat area, A_{LOBE}, by the total area of the habitat area, $A_{Habitat}$, results in the fraction of habitat exposed, $F_{Habitat}$. The daily fraction can be expressed as follows

$$F_{Habitat}(t_i) = \frac{A_{LOBE}(t_i)}{A_{Habitat}} \cdot 100,$$

where t_i represents each individual day *i* within the assessment period. The daily fraction of the habitat area per day or assessment period can vary between 0% and 100%.

This shall result in 365 (366) estimates of $F_{habitat.}$ Hence, the average fraction of exposed area above LOBE during the assessment period can be determined.

Further details are provided in the thematic noise assessments and the 2023 MED QSR Pollution Assessment.

Expected assessments outputs

The assessment outputs are the following:

- Summary statistics: number of days with impulsive noise, extent of assessment area covered by noise events (in km² or %)
- GIS maps showing the spatial and temporal distribution of noise sources over a year, or calculated monthly or quarterly (exposure maps);
- Assessment statistics: % of affected habitat ($F_{habitat}$) per species considered, per assessment area (e.g., sub-division, sub-region, region).

Known gaps and uncertainties in the Mediterranean

The main uncertainties lie in the availability of declarative data (location, period and intensity of noise sources), although experience from the implementation of the MSFD in the last 15 years as well as the recent activities on IMAP-EO11 are encouraging.

Another important issue is the general perception that underwater acoustics is too complex and noise monitoring generally too expensive. However, this Candidate Common Indicator 26 was conceived to cut out most of the complexity which can be found in the science related to underwater acoustics, simplifying extremely the monitoring methodology and minimizing the costs of implementation. Therefore, an emphasis should be put on correct dissemination of the information on how this indicator is built.

By building on the achievements up to 2023, during the preparation of the 2023 MED QSR, several knowledge gaps were identified in the monitoring and assessment of Candidate Common Indicators 26 and 27, which need to be addressed following the recommendations of the 2023 MED POL Focal Points Meeting. Improving underwater noise data quality and availability is essential in addressing existing knowledge gaps. In this regard, the following specific actions should be undertaken by the Parties:

- A contribution should be provided to the ACCOBAMS regional register for impulsive noise sources, especially by sharing national data, along with the development of a cooperation mechanism to identify the source of long-distance underwater noise in order to address its long-distance effects;
- Reporting noise generating military activities is needed to provide an actual and precise assessment reflecting the real situation;
- An alternative approach needs to be tested by applying specific assessments for species and their habitats. For such an exercise, Important Marine Mammal Areas (IMMA) could be used as defined habitats.

Contacts and Version Date

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V.1	10/07/2016	ACCOBAMS
V.2	25/01/2019	ACCOBAMS in consultations with UN Environment/MAP
Final Version	31/05/2019	Acknowledged by the Meeting of MED POL FPs
V.4	28/05/2025	Joint CorMon Pollution and ML Meeting
V.5		Approved by the Meeting of MED POL FPs
Final Version		Approved by the 12th Meeting of EcAp Coordination Group

5. The revision of IMAP **Candidate Common Indicator 27 (EO11)**: **"**Levels of continuous low frequency sound with the use of models as appropriate" is presented in the table bellow.

Indicator Title	Candidate Common Indicator 27. Levels of continuous low frequency sound with the use of models as appropriate	
Relevant GES definition[7]	**Related Operational Objective**	**Proposed Target(s)**[8]
Noise from human activities causes no significant impact on marine and coastal ecosystems	Energy inputs into the marine environment, especially noise from human activities, are minimized	State: The extent (%) of the assessment area which is above levels causing disturbance to sensitive marine animal is below limits, or such limits are exceeded for a limited amount of time.
Rationale		
Justification for indicator selector Anthropogenic energy introduced by human activities into the marine environment includes sound, light and other electromagnetic fields, heat and radioactive energy. The most widespread and pervasive is underwater sound (Dekeling et al., 2014). Sound energy input can occur at varying spatial and temporal scales. Anthropogenic sounds may be of short duration (i.e. impulsive) or be long lasting (i.e. continuous). Lower frequency sounds can be transmitted far (tens to thousands of kilometres), whereas higher frequency sounds		

[7] Following the decisions to be made at the present meeting regarding the GES definition and minor adjustments to the Targets, as outlined in working document UNEP/MED WG.626/3/Rev.1, the revised Targets and GES definition will be incorporated into the revised IMAP Pollution Indicators Factsheets.

[8] ibidem

Indicator Title	Candidate Common Indicator 27. Levels of continuous low frequency sound with the use of models as appropriate

transmit less well in the marine environment (hundreds of meters to few kilometres (Urick, 1996). Most common sources of marine noise pollution in the Mediterranean Sea include ship traffic, geophysical exploration and oil and gas exploitation, military and civil sonar use and underwater detonations, scientific research involving the use of active acoustic sources, and offshore and inshore industrial construction works (ACCOBAMS, 2016;ACCOBAMS, 2022).

Marine organisms can be adversely affected both on short and long timescales (and include acute or chronic impact and temporary or permanent effects (Richardson et al, 1995). Adverse effects can be subtle (e.g. temporary reduction in hearing sensitivity, stress effects causing reduced immunity, reproduction success or survival), or more obvious (e.g. injury, death). The former may be difficult to observe and evaluate while the latter may in some circumstances be related to acute short-range noise exposures

This indicator addresses the continuous low-frequency sound produced by marine activities. The major contributor to this type of ambient ocean noise is produced by maritime traffic (Hildebrand, 2009; Hildebrand & Jesus, 2021; Jalkanen et al., 2022). For this reason, it has been pointed as an important factor potentially inducing degradation of the acoustic habitat of marine animals, and particularly cetaceans which are known to communicate over very long ranges through acoustic signals. Many studies also showed negative effects on fish. The degradation of the acoustic habitat may result in masking of the biological signals, displacement, reduced fitness and other effects that may have indirect impacts on populations, such as reduced reproduction, reduced foraging success, and hence a long term degradation of the survival rate of populations (Aguilar de Soto et al., 2006; Benhemma-Le Gall et al., 2021; Blair et al., 2016; Erbe et al., 2019; Pirotta et al., 2012; Putland et al., 2017; Tennessen & Parks, 2015; Williams et al., 2014; Wysocki et al., 2006).

Scientific References

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Policy Context and Targets

Policy context description

Shipping activities are regulated by the International Maritime Organization (IMO), the United Nations agency with responsibility for many aspects of shipping, including safety, maritime security, environmental concerns, legal and technical matters and efficiency. IMO is the source of several legal instruments, and among these the MARPOL Convention was signed with the aim of minimising pollution in oceans and seas. MARPOL includes 6 Annexes, each one addressing a category of pollution produced by ships: oil emissions, noxious liquids, packaged harmful substances, sewage, garbage, air pollution. Unfortunately, MARPOL defines pollution as substance, not energy, contrary to many other regulation bodies including other UN-related bodies such as the UN Convention on the Law of the Sea (UNCLOS). Underwater noise is therefore not addressed by MARPOL. However, in recent years the Marine Environment Protection Committee (MEPC) of the IMO addressed underwater noise produced by shipping. As a result, guidelines on the reduction of noise emission from ships were first issued in 2014, and then revised in 2023 (IMO, 2023). However, it is worth noting that such guidelines address noise radiated from single ships and the way to mitigate the emissions, while the general rising in ambient ocean noise due to increased shipping (i.e. an ecosystem approach) is not specifically addressed.

The MSFD and EcAp processes are the first legal instruments for monitoring, assessing and setting targets, at least for their competence areas (the European Union and the Mediterranean region, respectively). All the policy documents developed in the framework of such initiatives are therefore a novelty concerning the regulation of emissions of pollutants related to shipping. A closer cooperation with such global regulatory bodies as the IMO and MARPOL is certainly a major asset for the success of initiatives aimed at reducing ship radiated noise and the associated impacts, thus delivering good environmental status.

Beyond large scale regulation, many interesting initiatives are being proposed to strengthen the implementation of mitigation measures applied to shipping at a local scale. For example, some ports authorities are setting specific rules to foster ships complying with increasingly high environmental standards, including low noise emissions through reduced speed or displacement of ship lanes. One of the most known initiatives appears to be the port authority of Vancouver. Of course, the sum and synergy of increasing numbers of local initiatives has the potential to create a network big enough to produce positive effects at the ecosystem scale.

Targets

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The target is defined through a threshold system that combines data on shipping noise and information about the habitat of noise-sensitive species. This way, it is possible to move towards the assessment of whether the risk of the negative impacts occurring on populations of such species is acceptable.

This threshold system set is based on the continuous noise assessment methodology outlined in the 2023 MED QSR which was accepted by the Contracting Parties of the Barcelona Convention (the Meeting of Integrated Ecosystem Approach Correspondence Groups, 27-28 June 2023, Athens, Greece). The methodology applied for cCI27 assessment within the 2023 MED QSR is in turn based on previous activities carried out by ACCOBAMS and UNEP/MAP-SPA/RAC under the QUIETMED and QUIETSEAS projects (Azzellino et al., 2023; Maglio et al., 2021; Maglio, Frey, et al., 2018) as well as by the European Commission technical group on underwater noise (Borsani et al., 2023).

A single threshold is defined and it applies to the % of habitat of noise-sensitive species affected by continuous noise. Based on that, to achieve or maintain the Good Environmental Status, the following thresholds should be observed by the Contracting Parties:

1. **No more than 20% of the habitat of selected species should experience noise levels above the Level of Onset of Biological Effects (LOBE) exceeding in any given month (based on the average noise level for that month) during the assessment year**.

The threshold values are expressed as a range (X% or lower) in order to take regional and sub-regional specificities into account. Assessors select a specific threshold value within this range based on the assessment's context and purpose.. While the threshold is determined using available data, it may be adjusted as new scientific knowledge emerges.

Policy documents

ACCOBAMS Resolution 7.13 - Anthropogenic Noise. ACCOBAMS-MOP7/2019/Doc38/Annex15/Res.7.13. 2019

ACCOBAMS Resolution 8.17 - Anthropogenic Noise. ACCOBAMS-MOP7/2019/Doc38/Annex15/Res.7.13. 2023

Commission Decision 2017/848/EU of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision (2010/477/EU)

Decision IG.21/3 (COP18,2013) on Ecosystems Approach including adopting definitions of Good Environmental Status (GES) and Targets (UNEP(DEPI)/MED IG.21/9).

Decision IG.22/7 (COP19, 2016) on Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria (UNEP(DEPI)/MED IG.22/28).

Decision IG.25/1 (COP22, 2021) on UNEP/MAP Medium-Term Strategy 2022-2027.

Decision IG.22/7 (COP19, 2016) on the Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria.

Decision IG.23/6 (COP20, 2017) on 2017 Mediterranean Quality Status Report.

Decision IG.24/4 (COP21, 2019) on Assessment Studies.

Decision 26/3 (COP23, 2023) on the 2023 Mediterranean Quality Status Report and a Renewed Ecosystem Approach Policy in the Mediterranean.

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Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78).

IMO (2023). Revised Guidelines for the reduction of underwater radiated noise from shipping to address adverse impacts on marine life.

Indicator analysis methods

Indicator Definition

The main indicator is the average sound pressure level (SPL) in selected frequency bands (third-octave bands centred at 20, 63, 125, 250, 500, 2000), on a monthly basis, where:

SPL means Sound Pressure Level in dB (re 1μPa)

Additionally, the 33%-Exceedance Level may be calculated on an annual basis. The term "Exceedance Level" is defined by the international standard ISO 1996-1:2003(E) as the level exceeded during 33% of the analysed time window

Average SPL gives an overview of average noise conditions in the assessed time window (1 year); while the 33% Exceedance Level provides a view of the highest noise levels for about one third of a year, corresponding to roughly 4 months. The use of 33% Exceedance Level is based on the assumption that in the Mediterranean Sea marine traffic noise increases substantially in the Summer season (June to September) mainly due to leisure craft, but also to increased numbers of navigating ships due to better weather conditions. The 33% Exceedance level is thought to detect such phenomenon, as an additional indicator for GES assessment.

Concerning frequencies, they were chosen as follows:

20Hz, based on fin whale biological significance. 20 Hz is indeed the peak frequency of the vocalizations of fin whales and monitoring the 1/3 octave band centred at this frequency may help assessing the masking effect from anthropogenic noise sources:

- 63 Hz, based on the frequency bands where noise from shipping is most likely to dominate over other sources (consistent with MSFD ambient noise criterion)
- 125 Hz, based on frequency bands where noise from shipping is most likely to dominate over other sources (consistent with MSFD ambient noise criterion)
- 250 Hz, based on frequency bands where noise from shipping is most likely to dominate over other sources according to Mediterranean data (e.g. Pulvirenti et al. 2014)
- 500 Hz, based on frequency bands where noise from shipping is most likely to dominate over other sources according to Mediterranean data (e.g. Pulvirenti et al. 2014)
- 2000 Hz, based sperm whale biological significance. Although sperm whale click peak frequency has been identified in 5000 Hz (Madsen et al., 2002; Watkins et al. 1980), its lower peak frequency limit has been defined in 2000 Hz. It seems more relevant to use the lower peak frequency limit because it is more likely to be affected by anthropogenic noise and it requires lower sampling rates to be recorded, reducing the cost of monitoring equipment and data archiving volume.

Methodology for indicator calculation

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The calculation of the indicator requires to perform the following tasks:

- Analysing recordings from deployed acoustic equipment and computing graphs of sound levels against time, sound levels against frequency, or similar;
- Modelling the propagation of noise from continuous sources (ships) for estimating levels at large scales and for mapping the indicators in the assessment areas.

The metrics to employ are the following:

- Average Sound Pressure Level (central tendency) calculated monthly, either from recordings obtained from the field or based on a modelling process;
- Additionally, 33%-Exceedance level over a year may be used, meaning the level corresponding to the 67th percentile of the distribution of SPL values. This indicator appears as useful especially in case of analysis of recordings from long-term monitoring stations (1 year data) to highlight the effect of leisure craft.

When processing audio files obtained in the field, the samples to be used for statistical analysis are short cuts of sound recordings of fixed duration, where the number and duration of each sample may vary. As a general rule, samples of maximum 1 minute should be used.

For models, different approaches exist to obtain the required statistics: temporal approaches and probabilistic approaches. Regardless of the approach used for models, it is recommended to consider available guidance on the use of the models (see here-below the section “List of Guidance documents and protocols available”). Further details are also provided in the thematic noise assessments and the 2023 MED QSR Pollution Assessment.

Indicator units

Sound Pressure Levels expressed in **dB re 1µPa**

List of Guidance documents and protocols available

A basin-wide strategy for underwater noise monitoring in the Mediterranean. Report prepared by Alessio Maglio, Manuel Castellote and Gianni Pavan. (ACCOBAMS, 2015)

Best practice guidelines on acoustic modelling and mapping. 2017/848/EU and ACCOBAMS premises, and generalisation for the EcAp process. Deliverable 3.3, QUIETMED project. DG ENV/MSFD Second Cycle/2016. (Taroudakis et al., 2018)

Best practices guidelines on signal processing algorithms for the preprocessing of the data and for obtaining the noise indicator. Deliverable 3.2, QUIETMED project. DG ENV/MSFD Second Cycle/2016. (Vukadin et al, 2018)

Dekeling, R.P.A., Tasker, M.L., Van der Graaf, A.J., Ainslie, M.A, Andersson, M.H., André, M., Borsani, J.F., Brensing, K., Castellote, M., Cronin, D., Dalen, J., Folegot, T., Leaper, R., Pajala, J., Redman, P., Robinson, S.P., Sigray, P., Sutton, G., Thomsen, F., Werner, S., Wittekind, D., Young, J.V., 2014. Monitoring Guidance for Underwater Noise in European Seas, Part I: Executive Summary, JRC Scientific and Policy Report EUR 26557 EN, Publications Office of the European Union, Luxembourg, 2014, doi: 10.2788/29293.

End Report on GES criteria assessment at basin scale with focus on the consistency and coherence of approaches at national levels (including operational targets definition) - Deliverable 2.3. No. 11.0661/2016/748066/SUB/ENV.C2. (Maglio et al, 2018)

Indicator Title	Candidate Common Indicator 27. Levels of continuous low frequency sound with the use of models as appropriate

Impacts of noise and use of propagation models to predict the recipient side of noise. Report prepared under contract ENV.D.2/FRA/2012/0025 for the European Commission. Centre for Environment, Fisheries & Aquaculture Science, UK. , (July), p.27. Available at: http://mcc.jrc.ec.europa.eu/document.py?code=201601081529 (Borsani et al, 2015)

Proposal of a methodology to establish thresholds values for D11C2 in the Mediterranean and Black Sea regions. QUIETSEAS D5.2. (Azzellino et al, 2023)
QUIETSEAS Deliverable 9.1. Guidelines for Competent Authorities on a reporting method for continuous noise appropriate for the GES assessment and the establishment of thresholds.

Review of underwater acoustic propagation models, p.35. (Wang et al, 2014)

Review of risk-based approaches and frameworks for D11C2. QUIETDSEAS D3.1. (Maglio et al, 2021).

Data Confidence and uncertainties

Many sources of uncertainty exist concerning both measurements and models: the characteristics of the sound recorder used, the calibration, the mooring conditions and on the location of deployment (near or far from shipping lanes, in shadow areas, etc.), as well as many steps and settings of the data processing. Also, modelling methods contemplate a large number of variability factors often hindering meaningful comparisons among different monitoring programs. Such uncertainty results in well-known shortcomings in the understanding of how anthropogenic noise may affect the environment.

However, despite these sources of uncertainty, many steps forward have been done since the beginning of the implementation of the EcAp process, and considerable effort was done to develop guidance and best practices. Many of these efforts were focussed in northern European waters and the North Atlantic, but recent projects (QUIETMED, QUIETMED2 and QUIETSEAS) produced valuable work in the direction of laying down common methods and shared understanding of the several technical aspects.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

<u>General monitoring methodology</u>: the combined use of measurements and modelling is recommended. Notable is that models are necessary to carry out GES assessment. Continuous sound recording should be done at fixed sites through sound recording stations. Acoustic modelling and mapping through appropriate analytical procedures producing estimations to be validated from field measures.

The use of in-situ acoustic measurements is essential for:
- Gathering fundamental field data to establish information on the ambient noise in a given location
- Reducing uncertainty on source levels to be used as the input for modelling;
- Increasing evidence base to improve management decisions.

The use of models is essential for:
-
- Reducing the number of stations required to establish a trend over a fixed amount of time (similar reasoning to above), therefore reducing the cost of monitoring;
- Helping with the choice of monitoring positions and equipment (selecting locations where the shipping noise is dominant as opposed to explosions or seismic surveys being dominant);

Indicator Title	Candidate Common Indicator 27. Levels of continuous low frequency sound with the use of models as appropriate

- Producing noise maps, which are a valuable tool to quickly understand the ensonification levels over large areas, and the necessary tool to calculate the extent of impacted areas
- Predicting future scenarios and therefore testing different noise reduction strategies, e.g. by answering simple questions such as what happens if we reduce by XX dB the noise of 1% (or 20% etc.) of the circulating ships?

Monitoring Protocol: recordings are stored in a storage facility (server) during the year. These can be retrieved manually or automatically transmitted through appropriate networks (wi-fi, GPRS, Satellite) from the station to the server. Cabled sound recorders, directly connected to land, can also be used. Fieldwork is limited to deployment and maintenance of sound recorders. Data can be analysed once a year over the whole acoustic dataset obtained or periodically during the year. Models and mapping are computed through appropriate software once a year or with other suitable periodicity.

Contracting Parties within a subregion are recommended to work together to establish an ambient noise monitoring system. When defining such monitoring system, a number of aspects should be addressed (not exhaustive list): measuring equipment quality, calibration, deployment depth, mooring configuration.

Available data sources

Since 2020, the NETCCOBAMS platform provide maps of underwater continuous noise (based on shipping noise) in the whole ACCOBAMS Area (Mediterranean Sea, Black Sea, Atlantic area contiguous to the Mediterranean Sea).

It is expected that the European platform EMODnet shall include in the next future a section dedicated to underwater noise data made available from monitoring stations placed in waters surrounding the EU (thus with some good coverage of the Mediterranean Sea).

Input environmental data for acoustic modelling (depth, seafloor, temperature and salinity profiles, etc.) are available at many freely available data repositories (EMODnet, Copernicus, NOAA, etc.).

Input ship data (AIS databases) for acoustic modelling (ship positions, speed, vessel type, etc.) can be accessed through common AIS networks and/or suppliers.

Spatial scope guidance and selection of monitoring stations

Spatial scope: Contracting Parties should consider the whole maritime space under their jurisdiction for locating the acoustic devices, following the guidelines hereafter for selecting the location. Further, noise mapping based on sound propagation modelling provides an effective way of covering the whole maritime space of a country with limited costs.

Location of sampling sites:

- Monitoring in both high traffic and low traffic areas, also searching and including spots where the noise is supposed to be the lowest;
- Monitoring may be more cost effective if existing oceanographic stations included noise monitoring along with the other oceanographic variables already being monitored, such as European Multidisciplinary Seafloor Observation (EMSO) - European Seas Observatory Network of Excellence (ESONET-NoE);
- Consider local topography and bathymetry effects e.g. where there are pronounced coastal landscapes or islands/archipelagos it may be appropriate to place hydrophones on both sides of the feature;
- As far as possible avoid locations close to other sound producing sources that might interfere with measurements e.g. oil and gas exploration or offshore construction activities. Areas of particularly high tidal currents may also affect the quality of the measurement;

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- Monitoring station should be primarily located in important cetacean habitat, as identified by ACCOBAMS (Resolution 4.15);
- Whenever possible use deep monitoring stations, either autonomous or cabled, to limit the influence of surface and sub-surface noise.

Temporal Scope guidance

Monitoring stations should be able to **continuously** record underwater sound. The temporal scheme for the monitoring may vary according to the type of equipment and the logistics for recovering and/or retrieving data. It is desirable that the deployments cover all the year, but there is no recommended retrieval periodicity with regards to moored equipment.

With regards to modelled noise data, as the defined Target is to assess the % of habitat affected by continuous noise on a monthly basis, noise maps should be produced at least for 1 month and ideally for all months.

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

Appropriate analysis software (usually algorithms developed in some programming language such as Matlab and others) is used to derive average SPL (and 33%-Exceedance Levels). Considering the methodology applied for cCI 27 within the 2023 in MED QSR, any statistics reflecting the central tendency of the monthly scenario can be chosen (e.g., the median, the arithmetic mean, or other metric reflecting the central tendency).

For the processing of acoustic data, a sample of short cuts (segments) of sound recording (the samples for calculation of statistics) should be used to compute the noise metrics. As a general rule, the duration of single segments should not exceed 1 minute, unless otherwise decided and justified.

Finally, aggregation could be done through transboundary cooperation at the sub-regional level. The tool NETCCOBAMS is now being implemented by ACCOBAMS with this purpose for continuous noise. The NETCCOBAMS platform can host data about underwater noise levels in HDF5 format, as outlined in the Continuous Noise Data Call (issued in 2022 in the framework of the QUIETSEAS project)

With regards to data analysis for the assessment of the environmental status of a maritime area, the indicator need to be combined with information concerning the habitat of noise sensitive-species, in order to calculate the proportion of such habitat which is affected by impulsive noise.

By using models, it is possible to obtain noise maps providing an estimate of average noise levels over the areas assessed.The temporal resolution of the assessment (Temporal Assessment Window, TAW) is monthly:

- The first step is to determine the parts of the assessment area which are exposed to levels higher than the Level of Onset of Biological Effects (LOBE). This is done for every month of the year. This will result in an exposure map for the whole area which is assessed.
- The next step is to determine the extent of the habitat of selected noise-sensitive species in the assessment area ($A_{Habitat}$). This can be done with different methods, including refined habitat modelling and/or other GIS analyses. This part should be addressed consistently with relevant indicators under EO1 (Biodiversity).
- The next step is to determine the extent of the habitat which is exposed to noise higher than LOBE (A_{LOBE}).
- Dividing the exposed part of the habitat area (A_{LOBE}) by the total habitat area ($A_{Habitat}$) results in the fraction of habitat exposed, $F_{Habitat}$, which is expressed as:

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$$F_{Habitat}(t_i) = \frac{A_{LOBE}(t_i)}{A_{Habitat}} \cdot 100\%,$$

where t_i represents an individual month i within the assessment period (1 year). The daily fraction of the habitat area per month can vary between 0% and 100%.

Expected assessments outputs

The assessment outputs are the following:

- Levels of mean sound pressure level over a suitable temporal windows (month, season, year);
- Levels of 33% exceedance level over a year;
- Noise maps, i.e. maps showing the distribution of estimated noise levels across the assessed area.
- Noise exposure maps, i.e., maps showing the areas where the LOBE level is exceeded.
- Assessment statistics: % of affected habitat ($F_{habitat}$) per species considered, per assessment area (e.g., sub-division, sub-region, region), calculated on a monthly basis.

Known gaps and uncertainties in the Mediterranean

The Mediterranean present a majority of deep-water environment whose soundscape has been poorly studied, although some fixed deep monitoring observatories (2 stations of the EMSO/ESONET network, 1 in the NW Mediterranean, 1 in the Ionian Sea) provide long term acoustic data since many years. Obviously, many other temporary deployments from the '90s to date were done and data are available for reviewing levels, results, and more with a view of establishing baselines. However, common shortcomings (lack of standards for calibration, and the many source of variability highlighted above in this factsheet), may prevent from extracting meaningful information from such review concerning the Common Indicator 27. Further, the poor AIS coverage in some parts of the Mediterranean, especially the southern part, may affect the quality of monitoring through modelling techniques. However, the work done in the last 10 years on underwater noise from an ecosystem perspective enabled a better understanding, and thus a better management and mitigation, of the different sources of uncertainties.

By building on the achievements up to 2023, during the preparation of the 2023 MED QSR, several knowledge gaps were identified in the monitoring and assessment of Candidate Common Indicators 26 and 27, which need to be addressed following the recommendations of the 2023 MED POL Focal Points Meeting. Improving underwater noise data quality and availability is essential in addressing existing knowledge gaps, as outlined in the Guidance Factsheet for IMAP Ccandidate Common Indicator 26.

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V.1	10/07/2016	ACCOBAMS

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V.4		Approved by the Meeting of MED POL FPs

Appendix 6

Baseline Values (BV) and Threshold Values (TV) for IMAP Candidate Indicator 24

Table of Content

1. Introduction

1. The aim of this document is to develop the methodology for providing a statistical analysis for data collected by Contracting Parties, towards providing a first proposal for updating the Baseline Value (BV) and establishing Threshold Value for IMAP EO10 Common Indicator 24.

2. Definition of Baseline Value (BV): According to the definition provided by the UNEP/MAP (UNEP/MED WG.514/7[1]), "A baseline is a description of environmental state at a specific point against which subsequent values of state are compared". It may refer to a specified level of an impact or a pressure and act as a reference against which limit can be set or trends for the assessment of GES. Baselines can be derived from reference conditions, initial assessment values, the present state, or a potential/predicted issue."

3. Definition of Threshold Values (TV): The approach elaborated and used for the establishment of TV for the needs of preparation of the marine litter chapter of the 2023 Mediterranean Quality Status Report (MED QSR), is in line with the New GES Decision (2017/848) of the European Commission (EC), which provides a definition for the Threshold Values for marine litter: "Threshold value means a value or range of values that allows for an assessment of the quality level achieved for a particular criterion, thereby contributing to the assessment of the extent to which good environmental status is being achieved."

2. Data availability

4. Data has been made available thanks to the EU-funded projects: INDICIT I and II, INTERREG MED Plastics Busters MPAs, Marine Litter MED I and II; as well as contributions by several Contracting Parties.

5. A total of 2760 data submissions were initially received containing data on ingestion and entanglement from 10 Contracting Parties ranging from 1995 to 2024. The data submissions before 2010 are very ad hoc and do not contain details on marine litter. Considering the number of countries, number of data submissions, type and detail of the information (Figure 1), the period 2010-2020 has been selected as the most appropriate period to carry out the statistical analyses, including a total of samples/specimens; 290 specimens present both ingestion and entanglement.(Table 1) and 510 specimens described as bycatch and unknown were excluded from this analysis (Table 2).

[1] 8th Meeting of the Ecosystem Approach Coordination Group (EcAp CG), Videoconference, 9 September 2021.

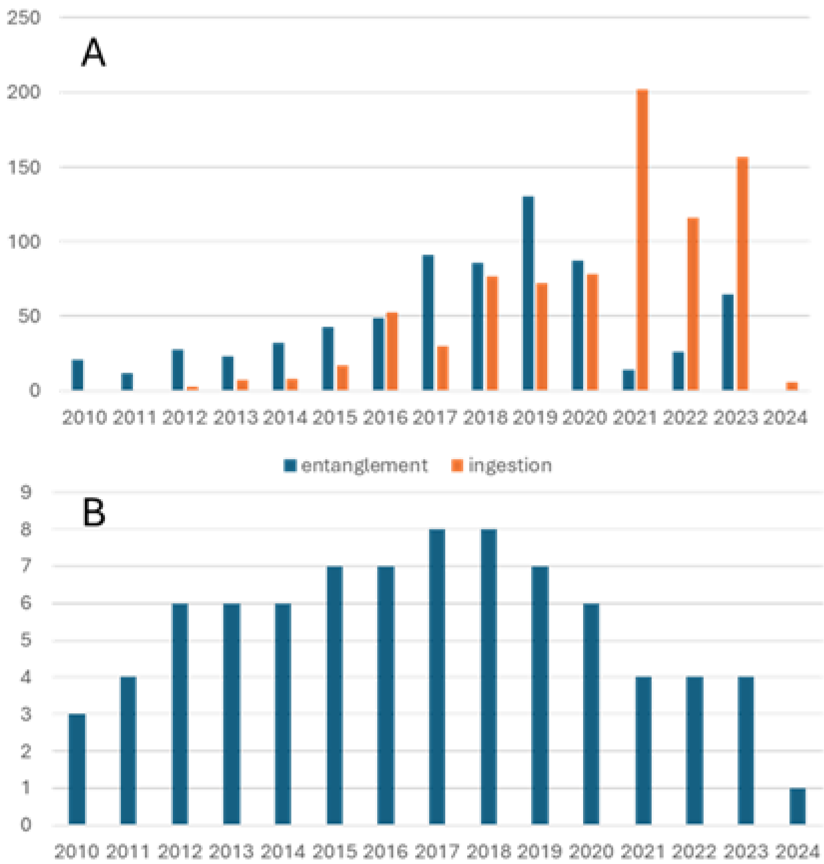


Figure 1: Data received by year (A), number of countries (B)

Table 1: Number specimens reported as affected by ingestion and/or entanglement by the Contracting Parties (2010-2020):

Country	Ingestion	Entanglement*
Cyprus	-	4
France	64	6
Greece	32	115
Israel	4	309
Italy	476	75
Lebanon	-	-
Malta	-	17
Spain	-	32
Tunisia	-	5
Turkey	4	22
Total	**580**	**581**

* *Bycatch and unknown were excluded from this analysis.*

6. Over the total number of reported specimens, 91% corresponds to the species *Caretta caretta*, 8,6% to *Chelonia mydas* and 0,4% to *Dermochelys coriacea* (Table 2). Only *Caretta caretta* specimens were considered for the analysis as other species *(C. mydas and D. coriacea)* have different feeding and behaviors.

Table 2: Species and the percentage of data related to entanglement and ingestion

Species	Number of Specimens	Entanglement	Ingestion	Other*
Caretta caretta	1255	24%	37%	39%
Chelonia mydas	120	35%	53%	12%
Dermochelys coriacea	5	0%	0%	100%
Unknow	1	-	-	-
TOTAL	1381			

*Other = bycatch and specimens without information about entanglement and ingestion.

7. For the *Caretta caretta* specimens reported on the ingestion form (total: 464, Table 2), 16% corresponds to samples where total dry weight ingested was zero (i.e., total dry weight ingested = 0), whereas the total number of specimens which were taken into consideration for the ingestion analysis is 391.

8. 24% of the *Caretta caretta* specimens sampled were reported by entanglement[2] (301 , Table 2), the specimens affected by “bycatch” and “unknown” categories have not been included in the analysis.

3. Methodology

9. Due to the mobility of marine turtles, for example loggerhead turtles can travel long distances, the transit time of ingested litter items usually is between 10 and 14 days (Valente et al., 2008; Solomando et al., 2022), and their different degree of conservation (i.e., alive, recently dead, mummified, etc.) is not considered appropriate to attribute encounters with marine litter (i.e. ingestion and/or entanglement) to the coordinates at which they were located. Although it is possible to assess the impact of marine litter on turtles at a regional scale by geolocation, the present analysis focuses globally and does not consider the location coordinates of the specimens.

10. The data collected can be used to calculate specific samples:

a) Frequency of occurrence: the proportion of turtles that have plastic in their gastrointestinal tract (also called "incidence" or "prevalence").
b) Arithmetic mean and standard deviation of the mean mass of marine litter found in the gastrointestinal tract (GI) of each specimen or the number of entangled objects. In case of a high standard deviation (non-normal distribution) the median is considered as a most appropriate value for the establishment of the baseline value (BL).
c) Threshold Value (TV): The reference level for the presence of plastics in the digestive tract of turtles (or any marine organism) is zero, as synthetic materials are exclusively man-made and were only introduced into the marine environment in the mid-20th Century (Kühn et al., 2022). However, assuming that accidental escapees (e.g. due to severe weather events, etc.) are inevitably occurring, an attempt will be made to indicate a possible TV.

11. All statistical analyses were performed with R 4.3.2 Statistical Programme (R Core Team, 2023).

[2] Considering as “entanglement” the data reported as such by the contracting countries on the form.

4. Ingestion

12. Since the first scientific publications on the topic, over 500 marine species have been listed for ingesting marine litter and sea turtles were among the first taxa recorded. Given their propensity to ingest litter, their wide distribution, and the large range of habitats used during their life, sea turtles, in particular the loggerhead species (*Caretta caretta*), have been chosen as indicator species for the Mediterranean basin (Matiddi et al., 2011-2017-2019).

13. A specific protocol to collect data on marine litter ingested by sea turtles has been developed and tested by ten partners in seven countries in the Mediterranean Sea and Atlantic Ocean within the European Project INDICIT (GA n°11.0661/2016/748064/SUB/ENV.C2) and harmonized with the Specially Protected Areas / Regional Activity Centre (SPA/RAC). The procedures for dead sea turtle necropsy, including the analysis of ingested litter have been specified in detail and published as a video tutorial by Matiddi et al. (2019).This protocol provides standardized methodologies for the analysis of marine litter ingested by sea turtles to support the new Commission Decision (EU)8, Criteria D10C3, and could be useful to support the IMAP Candidate Indicator CI24: "Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles".

14. The proposed protocol used for recording ingested litter by sea turtles will be useful in gathering data on the composition and abundance of litter and assess its impact on marine environments. Moreover, collecting this type of standardized data will help to define threshold values (Matiddi et al., 2017; 2019; 2024).

15. For updating the Baseline Value (BV) for Candidate Indicator 24, the median value of the amount of ingested litter by marine animals is considered as a better measurement of the central location of a value, than the average value in the case of a non-symmetric distribution (Baggelaar, Paul K. and Van der Meulen Eit C.J., 2014; Van Loon et al., 2020). This is due to the fact that the median value is less sensitive to extreme values (Van Loon et al. 2020).

16. The definition of Threshold Values (TVs) followed during the development of the marine litter chapters of the 2023 MED QSR and the EU GES assessment method for marine litter on beaches (Van Loon et al., 2020), recommend a TV equal to the 15th percentile of the total abundance of marine litter, a statistical method commonly used in assessments when accurate reference values of pristine areas are not available (Van Loon et al., 2020).

17. Considering that the number of items may be biased by different enumeration methodologies, (Matiddi et al., 2019), only the total dry weight assessed over the entire digestive tract has been proposed for the calculation of BV and TV.

18. For the calculation of BV and TV from the data of ingested marine litter, those specimens with information on the dry weight of the organic fraction and the dry weight of the ingested marine litter were considered, excluding specimens with a total ingested dry weight of zero (N=391 specimens).

19. A second sample with those specimens that had information on the units of the marine litter categories (N=44 specimens) was also analyzed.

20. The TV analysis was established for each specimen and then the specimens were grouped by year based on the median value, thus obtaining an annual value. The annual values were grouped by averaging them all to obtain the baseline value for ingestion under CI24.

21. In addition, an analysis was carried out according to the frequency of occurrence of each type of marine litter. The results show which objects are most frequently ingested by marine organisms, specifically by sea turtles in the Mediterranean Sea.

4.1. Determination of Baseline and Threshold Values for Ingestion

22. The calculation of the baseline is through the quantities (weight and/or units) found in the GI (Matiddi et al. 2024). The mean values obtained per turtle were 9 particles and 13,22 gr of marine litter (Table 3). However, due to a very high standard deviation and a non-normal distribution of the sample (Figure 2), the median value is 3 particles and 0.07 gr, it should be considered more representative (Table 3).

Table 3: Descriptive statistics parameters (total sample: 345)

	Average	Standard Deviation	Median	Perc 10	Perc 15	Perc 20
N° ML items	9	21	3	2	2	3
Weight ML (gr)	13,22	118,51	0.07	0.007	0.009	0.01

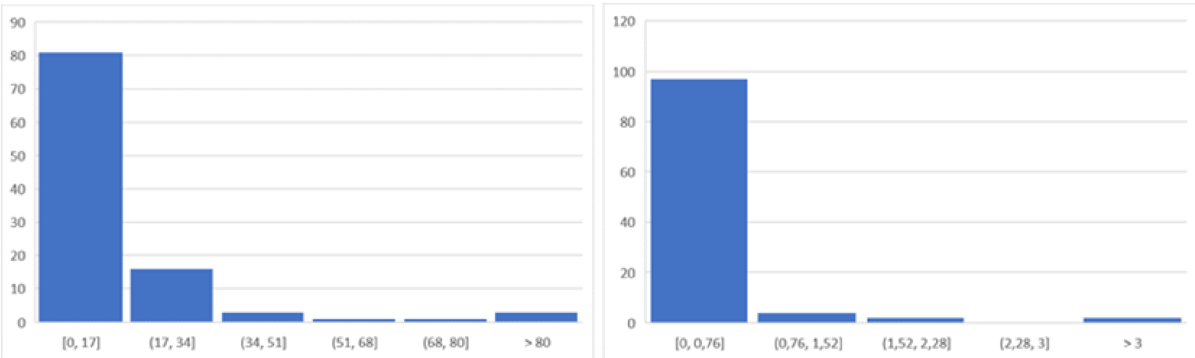


Figure 2: Frequency Histogram (Left: Item Number; Right: Marine Litter Dry Weight)

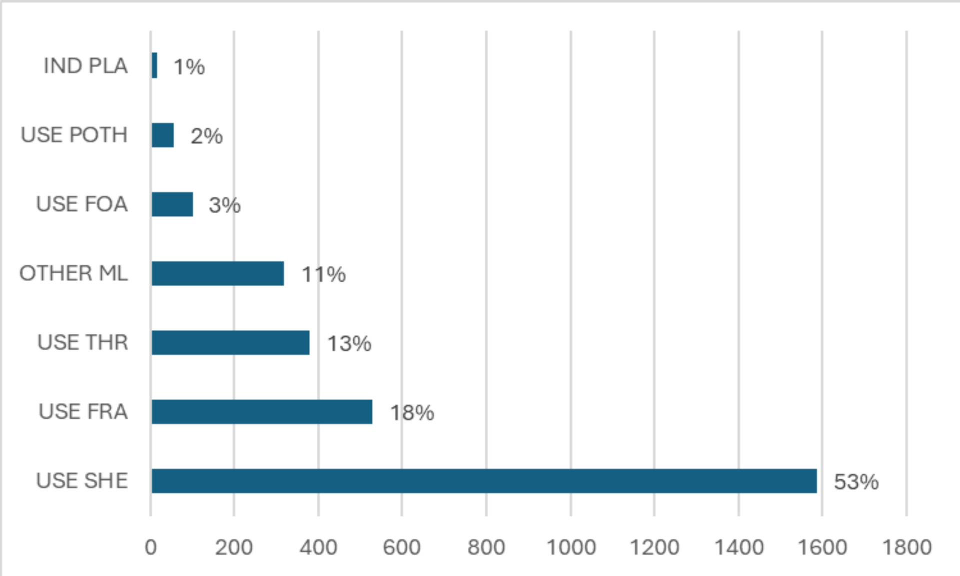
23. The analysis based on the dry weight of ingested marine litter is considered more appropriate than the one based on number of items due to the possibility of fragmentation of the pieces during the turtle feeding process ((Matiddi et al. 2019).

24. Based on these results, the **BV can be set at a dry weight of marine litter ingested of 0.07 gr**. To calculate the TV, the 15th percentile of the sample is proposed, as for other marine litter indicators (i.e., IMAP EO10 CIs 22 and 23) and thus the **TV can be considered a dry weight of 0.01 gr (i.e., 0.009 gr rounded to 0.01 gr) of marine litter in the gastrointestinal tract (GI)**.

25. The proposed values (i.e., BV and TV) should be understood as a first approximation due to the limited data availability. A differential statistical analysis has been applied on a small sample and the results may be affected by this, since differential statistics analysis should be done in large groups of data.

26. This type of analysis is in line with the analysis carried out for other marine litter indicators (European Commission, 2025) but for its proper application it is necessary to improve the quality and quantity of the data through the proper application of sampling and reporting protocols.

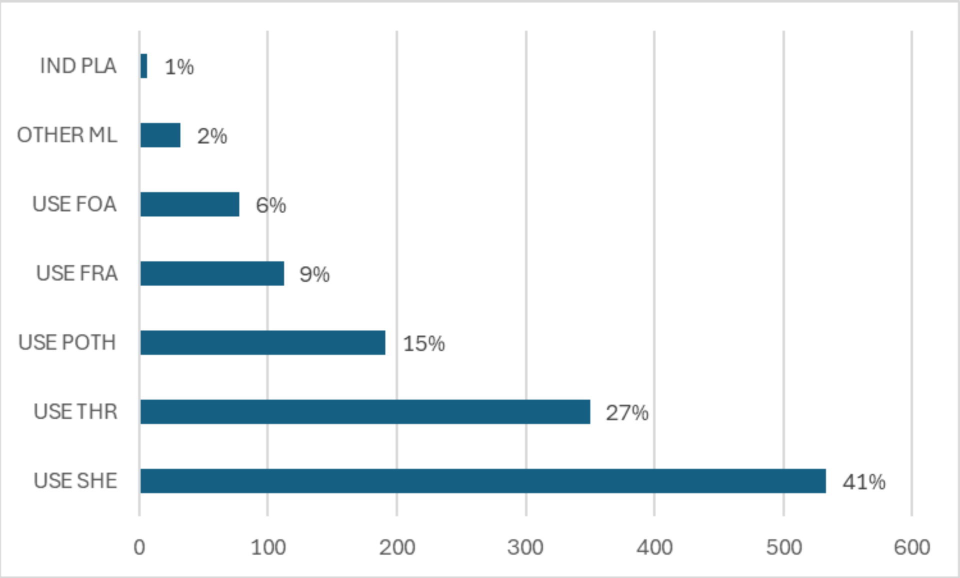
27. The most frequent item category is Remains of Plastic Sheets (USE SHE), e.g. from plastic bags, cling film, agricultural films, garbage bags, etc., which are assessed at the level of 53% (Figure 4), followed by plastic fragments (USE FRA 18%) (Figure 3).



***IND PLA**: Industrial plastic granules, usually cylindrical but also sometimes oval spherical or cubical shapes, or suspected industrial item, used for the tiny spheres (glassy, milky, etc.).*
***USE POTH:** Any other plastic type of plastics, including elastics, dense rubber, balloon pieces, soft air gun bullets, etc.*
***USE FOA:** All foamed plastics e.g. polystyrene foam, foamed soft rubber (as in mattress filling), etc.*
***OTHER ML:** Other marine litter.*
***USE THR:** Threadlike materials, e.g. pieces of nylon wire, net-fragments, woven clothing, etc.*
***USE FRA**: Fragments, broken pieces of thicker type plastics, can be a bit flexible, but not like sheet like materials.*
***USE SHE**: Remains of plastic sheets from bags, cling film, agricultural films, garbage bags*

Figure 3: Most frequent marine litter categories items by % of marine litter category (N=404)

28. The most frequent weight by category is Plastic Sheets (USE SHE 41%, Figure 4), e.g. from plastic bags, cling film, agricultural films, garbage bags, etc., followed by threadlike materials, e.g. pieces of nylon wire, net-fragments, woven clothing, etc. (USE THR 27%, Figure 4).



IND PLA: *Industrial plastic granules, usually cylindrical but also sometimes oval spherical or cubical shapes, or suspected industrial item, used for the tiny spheres (glassy, milky, etc.).* ***OTHER ML***: *Other marine litter.* ***USE FOA:*** *All foamed plastics e.g. polystyrene foam, foamed soft rubber (as in mattress filling), etc.* ***USE FRA***: *Fragments, broken pieces of thicker type plastics, can be a bit flexible, but not like sheet like materials.* ***USE POTH:*** *Any other plastic type of plastics, including elastics, dense rubber, balloon pieces, soft air gun bullets, etc.* ***USE THR:*** *Threadlike materials, e.g. pieces of nylon wire, net-fragments, woven clothing, etc.* ***USE SHE***: *Remains of plastic sheets from bags, cling film, agricultural films, garbage bags*

Figure 4: Most frequent marine litter categories (% weight by marine litter category, N=404)

29. In both cases (Figures 3 and 4), the most frequent category, well above the other categories, is USE SHE, (remains of sheet, e.g. from bag, cling-foil, agricultural sheets, rubbish bags, etc.).

5. Entanglement

30. The collected data are useful for assessing how marine litter affects/impacts sea turtles. The information can be divided into two categories:

(i) *General data* - recording by year of the number of animals affected by marine litter entanglement; and
(ii) *Individual data* - such as details on each event, the type of debris involved and its effects on specific animals - that allow analysis of the proportion of marine litter items that interact with the specimens recorded.

31. Distinguishing bycatch in fishing gear from entanglement is often challenging. When an animal is discovered entangled in fishing gear, it can be difficult to determine whether it became ensnared while the gear was actively in use, or if the gear had been abandoned or lost before the interaction occurred. Several criteria to help distinguish entanglement in marine litter from bycatch in active fishing gear are available into the Galgani *et al.*, 2023.

32. Data concerning entanglement has been reported by 9 countries. An analysis based on the median percentage of *Caretta caretta* affected specimens versus the total number of specimens collected is proposed as BV. The TV is the percentage of *Caretta caretta* affected specimens 15th percentile grouped by median by country and year.

33. The entangled analysis, period 2010-2020 comprising 301 specimens (Table 2) excluding individuals trapped by active fishing nets and reported as bycatch in the forms.

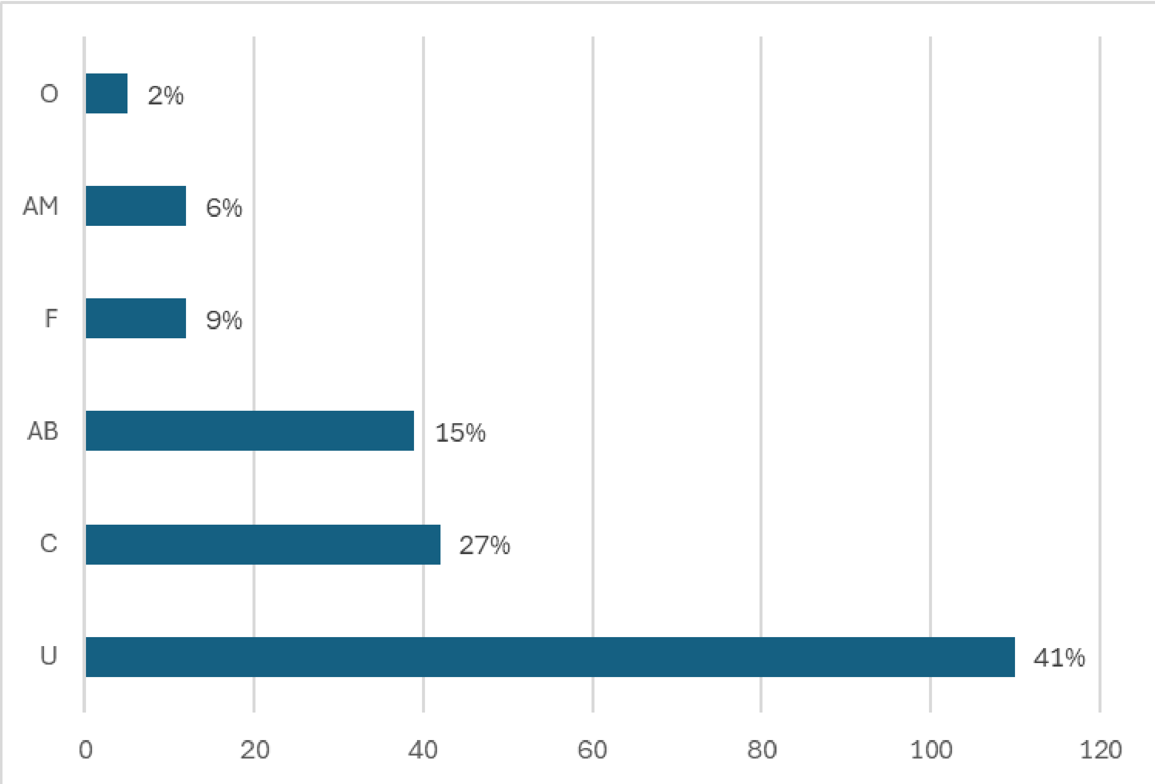
5.1. Determination of Baseline and Threshold Values for Entanglement

34. 24% of the *Caretta caretta* samples were affected by entanglement (301 specimens, Table 2). Some Contracting Parties only reported ingestion data for the period 2010-2020 or only a few individual specimens. To better approximate a frequency of occurrence value in the Mediterranean a possible approach is to use as BV the median frequency of occurrence during the study period, and as TV the 15th percentile.

35. The **proposed BV is 35%** of affected specimens by entanglement, whereas the best scenario in the Mediterranean is 11% (i.e. the case of France).

36. **The TV proposed is 9%** specimens affected by entanglement.

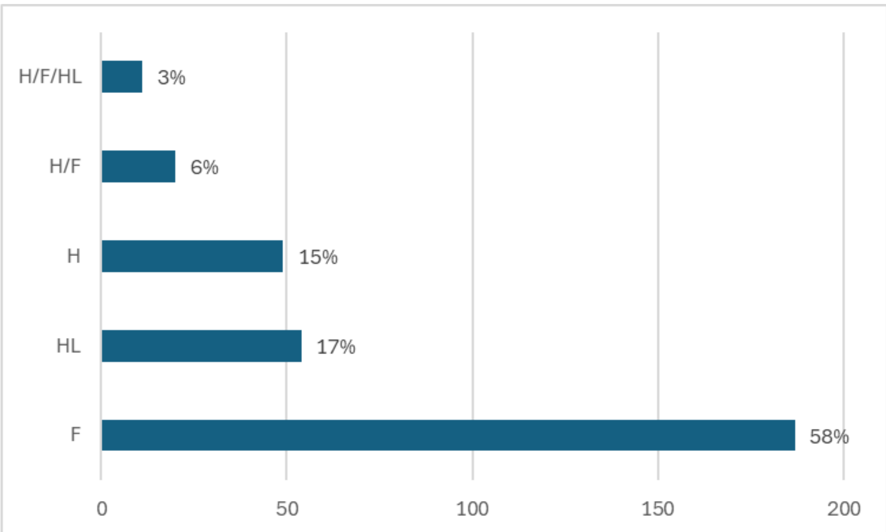
37. Most of the damaged ones were from undescribed lesion (U: 41%), cutting (C: 27%) and abrasion (AB: 15%) (Figure 5).



O: Other types of injury (infection, malnutrition, buoyancy, etc.)
AM: Amputation
F: Fracture
AB: Abrasion
C:Cutting
U: Lesion not identified or not described

Figure 5: Damages identified in the marine turtles (N=301)

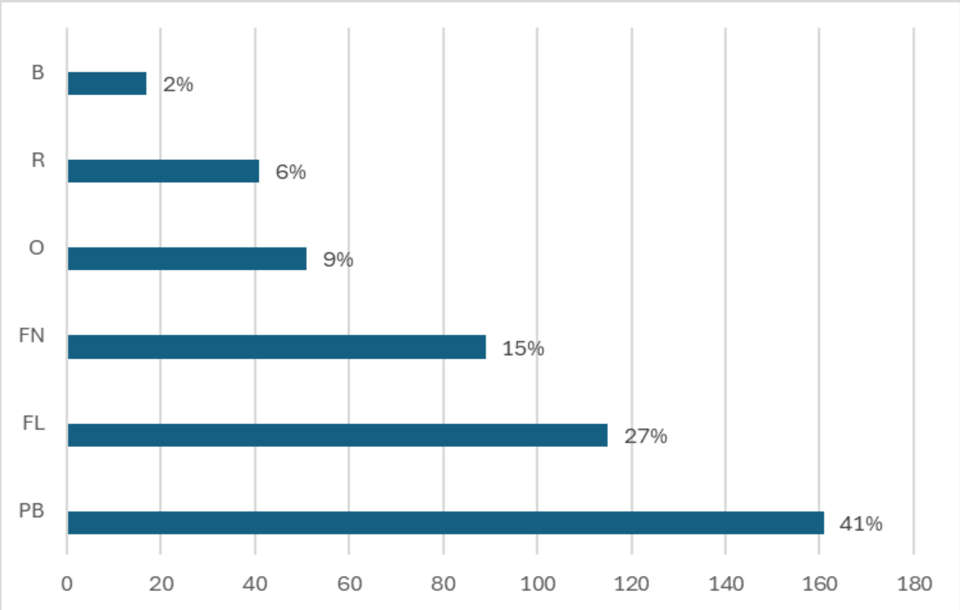
38. 58% of the entangled specimens show fin damage (F), whereas 17% of the entangled specimens show hind limbs damage (HL). (Figure 6).



H: Head; F: Forelimbs; HL: Hind limbs

Figure 6: Entangled body parts of marine turtles (N=301)

39. 30% of the turtles were classified with the presence of injury but no information relating to marine litter category. 40% of the turtles were classified with presence of injury and with information related to the source of marine litter, the main source is activities ashore and aquaculture activities (PB: 41%, FL: 27%, FN: 15%, Figure 7).



O: Other Material; FN: Fishing Net; R: Ropes. FL: Fishing line; B: Buoys/Fenders; PB: Plastic bags

Figure 7: Entangled marine litter items categories (N=301).

40. It is important to consider that approx. 65% of the data classified under the category “other materials” relates to heavy-duty sacks (Figure 7), which are usually associated with maritime transport.

41. Most abrasion and cut injuries are because of ropes (R) or fishing lines (FL), while suffocation is mainly attributed to Buoys/fenders (B) and plastic bags (PB) (Table 4).

Table 4: Damage/object relationship (N= 301):

Injuries	B	FL	FN	P	PB	R	RB
AB	13%	17%	20%	4%	4%	**42%**	
AB/C	6%	29%	12%			**41%**	12%
AB/C/AM	50%	50%					
AB/C/AM/S						100%	
AB/C/F/AM		100%					
AB/C/S			100%				
AB/S	33%	34%				33%	
AM		50%			50%		
C	17%	**42%**	8%			33%	
C/F		100%					
C/F/AM		78%				22%	
C/S		50%			50%		
F/AM			100%				
S	**29%**	14%	14%		**29%**	14%	

Injuries: AB = Abrasion, C = Cutting, F = Fracture, AM = Amputation, S = Suffocation
Object: FN = Fishing net, FL = Fishing line, B = Buoys/fenders, PB = Plastic bags,
R = Ropes, P = Packaging, RB = Rubber bands.

6. Conclusions

42. For ingestion:

a) **An updated BV can be established for the presence of marine litter particles in the digestive tract of Mediterranean turtles weighing 0.07 gr of dry weight of ingested litter.**
b) **A TV can be proposed at less than 0.01 gr of dry weight of litter in the gastrointestinal tract.**

43. For entanglement:

a) **The proposed BV is 35%**, which in fact is the median percentage of *Caretta caretta* specimens affected by entanglement.
b) **The proposed TV is 9%** of *Caretta caretta* specimens affected by entanglement **.**

Table 5: Proposal for updating the BV and establishing TV for IMAP Candidate Indicator 24 (for *caretta caretta)*

IMAP Indicator	Updated BV	Proposed TV
Common Indicator24: Ingestion	0.07 gr dry weight ML ingested	0.01 gr dry weight ML ingested
Common Indicator 24: Entanglement	35% affected sample	9% affected sample

44. Recent research highlights that the availability of natural foods can alter the incidence of marine litter ingestion (Matiddi et al., 2024). In this case, TVs should take into consideration not only the general distribution of data, but also the environmental context.

45. Analysis based on dry weight of ML ingested is considered more appropriate than that based on number of items due to the possibility of fragmentation of the pieces during the turtle feeding process (Matiddi et al. 2019).

46. Considering that the data used for this analysis were irregular as well as that more data would yield better results, the proposed BV and TV (Table 5) should be considered as a first approximation, being necessary a continuous revision and update in the next years, certainly before the third iteration of the Mediterranean Quality Status Report (MED QSR).

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