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Agenda Item 4: Update on the progress made in developing indicators using phytoplankton and zooplankton for pelagic habitats

Update on the progress made in developing indicators using phytoplankton and zooplankton for pelagic habitats

SPA/RAC
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Note by the Secretariat

Following the adoption of Decision IG.25/13 at the 22nd Meeting of the Contracting Parties (COP) to the Barcelona Convention, UNEP/MAP-SPA/RAC established a multidisciplinary group of experts appointed by the Contracting Parties. Their mission is to define parameters for using phytoplankton and zooplankton as biodiversity indicators within the IMAP framework and to develop a reference list of pelagic habitats in the Mediterranean for national monitoring.

The multidisciplinary group of experts convened online on April 5, 2023, and formulated conclusions and recommendations that were later adopted under Decision IG.26/5 at COP 23 (Portorož, Slovenia, December 5–8, 2023) and requested SPA/RAC to continue the work of the multidisciplinary group of experts to advance the development of the indicators using phytoplankton and zooplankton for relevant IMAP biodiversity indicators. This work will build on the outcomes of relevant ongoing projects in the region and be conducted in collaboration with relevant regional research centres.

During the CORMON Biodiversity and Fisheries Meeting (June 6–7, 2024), it was recommended that Mediterranean countries that have not yet appointed members to the Biodiversity Online Working Group (OWG) on pelagic habitats do so promptly to enhance the group's expertise and regional representation.
The OWG aims to discuss and agree on the approach, methods, and timeline for developing indicators based on phytoplankton and zooplankton for relevant IMAP biodiversity indicators.

This document summarizes the Working Group’s key recommendations and outlines the most appropriate approach for advancing these indicators. This document, prepared with the support of the OWG on pelagic habitats. The meeting is expected to review the document, provide guidance for the further development of indicators using phytoplankton and zooplankton for pelagic habitats, and agree on the proposed indicators and their submission to the SPA/RAC Focal Points Meeting (scheduled for May 2025) and the EcAp Coordination Group Meeting (scheduled for September 2025).

Update on the progress made in developing indicators using phytoplankton and zooplankton for pelagic habitats

1. Introduction

1. The Contracting Parties (CPs) to the Barcelona Convention agreed to implement the Ecosystem Approach (EcAp) process. In their 19th COP (Athens 2016), the CPs adopted the Integrated Monitoring and Assessment Programme of the Mediterranean Sea (IMAP) (Decision IG.22/7). To this end, the CPs decided to further strengthen their collaboration to reach a dual long-term goal: a. the achievement and maintenance of Good Environmental Status (GES) of the Mediterranean Sea and Coast, and b. achieving sustainable development through the SDGs and living in harmony with nature (MED QSR, 2023).

2. In relation to the achievement of GES, the Contracting Parties had adopted since 2012 the 11 Mediterranean Ecological Objectives (EOs). The EO1- Biodiversity of the IMAP Ecological Objectives defines that: "**Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions**". In order the CPs to assess the extent of GES or non-GES exists or achieved, 5 IMAP Common Indicators related to EO1 were also defined:

- ***Common Indicator 1***: Habitat distributional range (EO1) to also consider habitat extent as a relevant attribute;
- ***Common Indicator 2:*** Condition of the habitat's typical species and communities (EO1);
- ***Common Indicator 3***: Species distributional range (EO1 related to marine mammals, seabirds, marine reptiles);
- ***Common Indicator 4:*** Population abundance of selected species (EO1, related to marine mammals, seabirds, marine reptiles);
- ***Common Indicator 5***: Population demographic characteristics (EO1, e.g., body size or age class structure, sex ratio, fecundity rates, survival/mortality rates related to marine mammals, seabirds, marine reptiles).
- Among the 5 Common Indicators listed above, only CI1 and CI2 can be relevant for the study and assessment of plankton communities.

3. At this point it must be noted that the CPs to the Barcelona Convention at COP 22 (Antalya, 2021) nominated a multidisciplinary group of experts with the aim to define parameters allowing to use phytoplankton and zooplankton for relevant IMAP biodiversity indicators and elaborate the List of Reference of Pelagic Habitat Types in the Mediterranean Sea. The conclusions and recommendations were adopted at COP 23 (Slovenia, December 2023) and presented at the Meeting of the Ecosystem Approach Correspondence Group on Monitoring (CORMON)-Biodiversity and Fisheries in June 2024.

4. The main pressures on pelagic habitats have been identified, namely hydroclimatic conditions and shifts in light of climate change, eutrophication, biological invasions, contaminants (chemicals and marine litter), overfishing, aquaculture, physical disturbance due to the influence of man-made structures, acidification and maritime traffic. In order to effectively use phytoplankton and zooplankton as indicators of ecosystem health, the following parameters have been proposed to be monitored: abundance of species/genera or groups (for both phytoplankton and zooplankton) Chl-a concentration, dry weight for zooplankton, and size/biovolume.

5. At the same time, it was requested to continue the work to advance knowledge using phytoplankton and zooplankton for relevant IMAP biodiversity indicators, based on the outcomes of relevant recent projects in the region (i.e., ABIOMMED project). Although progress has been made in developing indicators based on phytoplankton and zooplankton, continued research and development are needed to define these indicators and improve their usefulness for assessing pelagic habitats. Liaison with OSPAR

commission was discussed and with the Joint Research Centre (JRC) of the European Commission, in order to be in coherence with the EU Marine Strategy Framework Directive (MSFD).

6. Following these activities SPA/RAC organized the first meeting of the Biodiversity Working Group (BWG) on pelagic habitats to provide technical expertise and recommendations and agree on the indicators for Ecological Objective 1-Pelagic Habitats, using phytoplankton and zooplankton. A coordinator has been nominated to deliver services to the BWG and organize the work.

7. The aim of the BWG is to facilitate the contribution of the CPs' scientists to the finalization of the EO1 in relation to Pelagic Habitats and more specifically to:

- Agree on the use of different components of plankton assemblages (phytoplankton and zooplankton) to assess the biodiversity status, in alignment with existing frameworks such as the Marine Strategy Framework Directive (MSFD) and regional sea conventions like OSPAR and HELCOM;
- Discuss targets and threshold values that could be defined for those components in relation to ecologically relevant assessment areas for assessing the Good Environmental Status (GES) of pelagic habitats;
- Identify data gaps and needs in the Mediterranean Sea;
- Propose innovative approaches to improve monitoring and assessment;
- Harmonize methodologies and data collection processes at national and regional levels.

8. At this point we need to state that in order to determine the most relevant approach to develop IMAP common indicators using phytoplankton and zooplankton for the Ecological Objective 1 on Pelagic Habitats, it is necessary to review/study, for example, existing international and European directives/guidelines, the consistency of methodological recommendations contained in other Regional Marine Conventions, EU projects, international and regional organizations related to the assessment of marine ecosystems. Such a harmonized roadmap also aims towards the identification of the appropriate policy interventions, support EU and UNEP/MAP policy framework implementation and also improve synergies between them. This "harmonization" process relates to the definition of monitoring, the Descriptors/EOs and their criteria/CIs, targets and objectives, considering that IMAP and MSFD have many similarities, in terms of definitions and targets agreed upon, that makes it possible.

9. The Biodiversity Online Working Group on Pelagic Habitats first met online on both the 23rd January 2025, and 20th February 2025. These meetings led to the following discussions and recommendations, based on best practices from different European regional seas (such as HELCOM and OSPAR areas), national approaches and on the previous work done in the framework of ABIOMMED project (Funded by DG Environment, under grant agreement No 110661/2020/839620/SUB/ENV.C.2–ABIOMMED project: Support coherent and coordinated assessment of biodiversity and measures across Mediterranean for the next 6-year cycle of MSFD implementation).

2. Marine Strategy Framework Directive (MSFD)

10. In the Mediterranean there are CPs that are also EU Member States, which have to implement MSFD and according to its article 17(2), were to update their marine strategies every six years (Articles 8, 9 and 10). Therefore, and in agreement with the statement above in relation to the similarities between IMAP and MSFD, a summary of MSFD requirements regarding biodiversity and more specifically plankton diversity is presented here.

11. The Marine Strategy Framework Directive (MSFD) was adopted in 2008 as a legal instrument of the European Union aiming to protect more effectively the marine environment across Europe and to protect the resource base upon which marine-related economic and social activities depend. In 2010 with the MSFD framework a Decision on GES was achieved, which was further revised in 2017

(Commission Decision (EU) 2017/848). Moreover, the MSFD at large is currently undergoing through a review process in consultation with the EU Member States.

12. MSFD also requests that the EU Member States take the necessary measures to achieve and/or maintain a Good Environmental Status (GES) of the marine environment. GES, as targeted by the MSFD, corresponds to the proper functioning of ecosystems (at the biological, physical, chemical and health levels) allowing the sustainable use of the marine environment.

13. The Decision 2017/848 specifies the scale of assessment to be 'Subdivision of region or subregion reflecting biogeographic differences in species composition of the broad habitat type.' The regions and subregions are specified in MSFD Article 4 of which a map was agreed by the MSFD Common Implementation Strategy (CIS). Since the first reporting in 2012 of the initial assessment (MSFD Article 8), it has been the practice to geographically delineate the areas used for reporting (termed Marine Units in 2012, but now referred to as Marine Reporting Units – MRUs). This is to ensure that the information reported is clearly linked to specific parts of a marine region, subregion or Member State's marine waters, and to enable the reported information to be displayed in maps to show, inter alia, the extent to which GES has been achieved (for example in WISE-Marine). The MRUs used in the MSFD during the 1st reporting cycle (2012-2018) and those submitted to be used during the 2nd reporting cycle (2018-2024) can be found at https://discomap.eea.europa.eu/INSPIRE/GMLMarine/atomMarineReportingUnits.xml.

14. In relation to Biodiversity in MSFD, Descriptor D1-Marine Biodiversity is addressing it defining that: "**Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions**". However, relevant information to Biodiversity on plankton components in MSFD can be derived also from the assessment of Descriptor D4 on Food webs since specifications for D4 ask: 1) Species composition shall be understood to refer to the lowest taxonomic level appropriate for the assessment; 2) The trophic guilds selected under criteria elements should consider the ICES list of trophic guilds and should meet several conditions among which one is to include at least three trophic guilds and at least one should be a primary producer trophic guild.

15. Descriptor D1 is structured around 6 primary and secondary criteria, of which the last one is related to pelagic habitats and is relevant to both CI1 and CI2 of IMAP.

> ***D1C6*** — *Primary:* The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g., its typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), is not adversely affected due to anthropogenic pressures.

16. MSFD (848/2017) in relation to D1C6 asks "Member States to establish threshold values for the condition of each habitat type, ensuring compatibility with related values set under Descriptors 2 (Non-Indigenous Species), 5 (Eutrophication) and 8 (Contaminants), through regional or sub-regional cooperation". Also, criteria elements to be assessed for D1C6 refer to broad habitat types as follows: "Pelagic broad habitat types (variable salinity, coastal, shelf and oceanic/beyond shelf), if present in the region or subregion. Member States may select, through regional or subregional cooperation, additional habitat types according to the criteria laid down under 'specifications for the selection of species and habitats". Methodological standards define the "Scale of assessment" as: Subdivision of region or subregion as used for assessments of benthic broad habitat types, reflecting biogeographic differences in species composition of the habitat type; and for the "Use of criteria": The extent to which Good Environmental Status has been achieved shall be expressed for each area assessed as: (a) an estimate of the proportion (percentage) and extent (in square kilometers (km2) of each habitat type assessed that has achieved the threshold value set; (b) a list of broad habitat types in the assessment area that were not assessed. Furthermore, it is explained that: 1) "Coastal" shall be understood on the basis of physical, hydrological and ecological parameters and is not limited to coastal waters as defined in Article 2(7) of Directive 2000/60/EC. 2) Assessments of the adverse effects from pressures, including under D2C3,

D5C2, D5C3, D5C4, D7C1, D8C2 and D8C4, shall be considered in the assessments of pelagic habitats under Descriptor 1.

3. Definitions and Rationale for Biodiversity Common Indicators of IMAP

17. When comparing the GES definitions for pelagic habitats, the level of coherence among the eight Mediterranean MSs was assessed as low (Varkitzi et al., 2018). GES was mostly defined on a conceptual basis, and only in some of the MSs directly in relation to pelagic habitats. To define tailored GES for pelagic habitats, phytoplankton and zooplankton communities, as biotic components of the pelagic habitat, have to be included as relevant indicators. Additionally, there is a need to set threshold values for those components in relation to ecologically relevant assessment areas, and to improve the coherence of GES definition across the Mediterranean.

18. Under the EcAp and IMAP umbrellas of Barcelona convention, the two common indicators for assessing the pelagic habitat of the Mediterranean Sea are proposed (CI1: Habitat distributional range and CI2: Condition of the habitat's typical species and communities), for which a common reference list of pelagic habitat types have to be agreed. An additional challenge is posed by the fact that the status of pelagic habitat has to be assessed as the extent of habitat adversely affected in km² or as % of the total extent per habitat type, which is hardly supported by the monitoring data at present. In the preparation of such a reference list, UNEP/RAC/SPA adopted an approach of considering the distribution of primary productivity in terms of Chl-a concentrations in combination with the reporting guidance under the MSFD (European Commission 2012), which already considers a simplification of EUNIS classification (UNEP/RAC/SPA, 2013). This tentative list of pelagic habitat types has been revised in 2023 in UNEP MED WG 548/7 document and adopted at the 16th Meeting of SPA/BD Focal Points - Malta, 22-24 May 2023 (Table 1). The typology of pelagic habitats represents a general framework that can be adapted and modified by CPs to integrate local ecosystems features and dynamics.

Table 1: Reference list of pelagic habitat types in the epipelagic layer (0 – 200 m) of the Mediterranean Sea

	Pelagic Habitat Types	Water mass	Comments
A.1.	Reduced salinity water	coastal lagoons	WFD correspondence [1]
A.2.	Variable salinity water – high surface or subsurface CHL (>3 mg/m3)	estuaries, river plumes	Transitional water[2] (values should be revised)
A.3.	Marine water: neritic - medium surface CHL (0.5-3 mg/m3)	upwellings, re-suspension in shallow waters and outskirts of river plumes, winter mixing areas	WFD type II, type III
A.4.a	Marine water: oceanic - medium surface CHL (0.5-3 mg/m3)	Upwellings, and winter mixing areas	WFD type III
A.4.b	Marine water: oceanic – low to medium surface CHL (~0.1- 1.0 mg/m3)	Hydrological features (fronts and gyres)	WFD type III
A.5.a.	Marine water: oceanic - very low surface CHL (<0.2 mg/m3) with deep CHL maximum	euphotic depth > mixed layer depth	WFD type III
A.5.b.	Marine water: oceanic - very low surface CHL (<0.1 mg/m3) without deep CHL maximum	euphotic depth < mixed layer depth	WFD type III

*Each country should specify the range of CHLa, Salinity, depth and if annual/seasonal values are used.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018D0229&from=PL

[2] WFD Annex 2 part 1.2.3. defines Transitional waters. see also Guidance document n.o 5 , Transitional and Coastal Waters, Typology, Reference Conditions and Classification Systems and Water Framework Directive Intercalibration Technical Report - Part 3: Coastal and Transitioal Waters

19. In addition to the tentative list of habitat types in the epipelagic domain, the IMAP document provided representative sites and species to be included in the monitoring programs of the Mediterranean countries (Annex 1, UNEP/MAP, 2016). Key features from this Annex related to pelagic habitats are listed in Table 2. The minimum of monitoring requirements outlined in this document contain only general guidelines for assessing phytoplankton and zooplankton communities. Priority 1 was given to plankton communities in coastal waters, while for shelf and oceanic waters, the priority still needs to be more clearly defined. However, the classification of pelagic habitat types in the Mediterranean Sea remains incomplete and requires further collaborative efforts to reach a common comprehensive framework.

Table 2: Minimum reference list of species and habitats for monitoring programs in the part related to pelagic habitat types of the Mediterranean Sea (from UNEP/MAP, 2016).

Predominant habitat or "functional" group of species	**Specific habitat type or species to be monitored**	**Additional information: specific representative species or habitats**	**Assessment monitoring scale**
Water column - coastal waters	Coastal waters phytoplankton communities	HABs	national / sub-regional
	Coastal waters zooplankton communities	cf. jellyfish population dynamics and blooms	national / sub-regional
Water column - shelf and oceanic waters	Shelf and oceanic waters phytoplankton communities	HABs	sub-regional
	Shelf and oceanic waters zooplankton communities	cf. jellyfish population dynamics and blooms	sub-regional

20. In the ABIOMMED project (Francé et al., 2023; Zervoudaki et al., 2023), the partners in contact with SPA/RAC colleagues searched for opportunities to link the IMAP policy to the work already carried out for the MSFD, particularly for pelagic habitats (phytoplankton and zooplankton) for EO1. Many phytoplankton and zooplankton indicators could be used as “early warning indicator” of environmental changes and as a sentinel of changes happening in the food webs and ecosystems (surveillance indicator as defined by Bedford et al. 2018).

21. In the long process of developing the environmental assessment systems with plankton indicators there are several obstacles that have to be overcome. First, the necessary step of linking the response of plankton communities to human pressures is usually difficult to accomplish, since this linkage is often non-linear (Francé et al., 2021; Ninčević Gladan et al., 2015). Besides this, the constrains for the wider use of such indicators for the assessment of environmental status largely relate to the difficulty in establishing the reference conditions and environmental objectives for these indicators (Garmendia et al., 2013). Moreover, the applicability of diversity indices to assess the status of the marine environment in a management context depends on the objective of the study, their ecological relevance, the mathematical properties of a certain index, their sensitivity to sampling efforts and ease of interpretation by stakeholders (OSPAR, 2017).

22. On the other hand, the main advantages of using diversity indices are their advanced development within the scientific literature and their ease of calculation (OSPAR, 2017c). In the case of phytoplankton community, the diversity indices based on abundance and richness are generally calculated on the entire plankton community, which includes also heterotrophic species and can provide additional information for assessing pelagic habitats (Domingues et al., 2008) in contrast to using solely indicators based on chlorophyll-a. However, the integration of chlorophyll-a with diversity data may provide an even better understanding of environmental conditions, because the inclusion of additional metrics can increase the sensitivity of an index (Garmendia et al., 2013).

23. Regarding zooplankton indicators, within the ABIOMMED project, experts agreed that among the examined and proposed indicators there is not a disputable single indicator that would reflect all the changes in zooplankton community needed for the assessment of biodiversity status. It was also recognized that the best way forward is to test in case studies the combination of bulk indicators, taxonomy-derived indicators and lifeform-based (functional) indicators to capture the changes in zooplankton communities that could have implications for ecosystem functioning. According to the catalogue of indicators examined within the ABIOMMED project (see Table 1 in Zervoudaki et al., 2023), the development of indicators is based mainly on the following zooplankton metrics: total abundance, total biomass, copepod abundance, % copepod abundance, copepod biomass, % copepod biomass (since copepods are often the most abundant group in the mesozooplankton community), microphagous species biomass, % microphagous species biomass, cladocerans/copepods ratio, rotifers+cladocerans/copepods ratio, zooplankton mean size. However, the development of usable zooplankton indicators in the Mediterranean Sea has lagged behind other European Seas, generally hampered by slow progress in standardization of methods and metrics as well as large research efforts and long history of data collection that have favored individual approaches and low levels of synchronization among Mediterranean zooplankton research groups. Therefore, within ABIOMMED and depending on data availability the most suitable indicators agreed upon by the partners were tested in a total of 5 Mediterranean MRUs (Tyrrhenian, Adriatic, Ionian, Aegean and Levantine Seas) within the defined spatial and temporal scales.

4. Outcomes of the Biodiversity Online Working Group for Pelagic Habitats

24. D1C6 of the MSFD (pelagic habitats) include plankton communities as an important component of water column habitats and the composition of these communities can provide a good indication of the status of pelagic ecosystems. According to the criterion D1C6, the condition of the habitat type is considered as a whole of its biotic and abiotic characteristics and its functions. GES has to be defined for pelagic broad habitat types (variable salinity, coastal, shelf and oceanic/beyond shelf), and it allows for more habitat types if their need is established through (sub)regional cooperation.

25. The ABIOMMED project aimed to support the competent authorities of the Mediterranean region, as well as the UNEP/MAP for a (sub)regional cooperation. In particular, the ABIOMMED Activity 2 was related to pelagic habitat and the use of the plankton communities to properly address the status of pelagic habitat and relevant spatio-temporal scales and pressures. Under this concept, ABIOMMED provided a comprehensive input and the essential resources to contribute to the development of relevant IMAP biodiversity indicators based on phytoplankton and zooplankton.

26. To build indicators and GES, key research gaps were identified:

- The gaps include general constraints related to the nature of the pelagic domain, the biology and ecology of planktonic organisms, and the methodologies used for the monitoring.
- Expert-dependent precision in taxonomic analysis and the lack of understanding of diversity drivers and dynamics constrain the development of specific diversity indicators and functional-groups indicators.
- Even in the absence of anthropogenic pressure, phytoplankton and zooplankton communities are highly dynamic.
- As it is extremely difficult to establish reference conditions, phytoplankton and zooplankton communities must be described based on their state under completely/nearly completely undisturbed conditions, with little/no impact from human activities. A comprehensive picture of ecosystem status specifically related to climate change pressures is lacking in MSFD, although UNEP/MAP in MED QSR 2023 considers climate change one of its six objectives.
- There is a lack of monitoring data availability, at present, in order to assess the extent of habitat adversely affected in km^2 or as % of the total extent per habitat type. Furthermore, due to the dynamic nature of plankton the state of a plankton community should not be evaluated by comparing its composition and relative abundance to a static “reference” species

assemblage. For these reasons, the development of pelagic indicators for D1C6 criterion of the MSFD is clearly behind the degree of development of other D1 (Biodiversity) criteria and other descriptors of the MSFD.

27. Pelagic habitats are closely linked to several Ecological Objectives of the EcAp, mainly EO4 Marine Food Webs, EO5 Eutrophication. It is important to establish connections among Ecological objectives by improving data collection and sharing, data harmonization and interoperability, etc.

28. Regional sea conventions (RSC) have long considered plankton communities as a key element for integrated assessment systems and some of the approaches from other RSC could be further tested and adapted to the specificities of the Mediterranean plankton communities. In OSPAR QSR 2023 two approaches were used by Holland et al. (2023) for Pelagic Habitat indicator 1 (PH1) "Changes in phytoplankton and zooplankton communities": a.) use of functional groups independantly to assess tendancies and importance of changes in relation to environmental variables; b.) test the variability of lifeform pairs (Tett et al. 2008) to estimate changes in lifeforms using a synthetic metric, the plankton index. Lifeforms are based on traits such as size, trophic cascades, motility, and other key biological features. Such lifeforms include: diatoms/dinoflagellates, large (≥ 20 μm diameter)/small (< 20 μm diameter) phytoplankton, microphytoplankton/non-carnivorous zooplankton, holoplankton/ meroplankton, crustaceans/gelatinous zooplankton etc. and should be adapted to the specific features of Mediterranean plankton communities (Varkitzi et al. 2018). Both abundance and biomass data can be used to inform lifeform pairs, depending on the lifeform in question and data availability from monitoring programs. In OSPAR Intermediate Assessment 2017, Pelagic Habitat indicator 2 (PH2) "Changes in Phytoplankton Biomass and Zooplankton Abundance" provides an indication of temporal deviations in total phytoplankton biomass or total copepod abundance from the assumed natural variability and Pelagic Habitat indicator 3 (PH3) "Changes in plankton diversity" identifies changes in the community structure using taxonomic diversity indices (alpha and beta diversity indices).

29. In the Baltic Sea (HELCOM), the pelagic habitat is assessed by different indicators for the open and coastal sea areas. For the open sea areas, three indices are applied: "Zooplankton mean size and total stock" as biodiversity core indicator, "Chlorophyll-a" as eutrophication pre-core indicator and "Cyanobacterial Bloom Index" as eutrophication pre-core test indicator. "Chlorophyll-a" is also applied in the coastal areas together with "Phytoplankton biovolume". Some indicators are still under development: "Diatom/dinoflagellate index", "Seasonal succession of dominating phytoplankton groups".

30. In the Mediterranean Sea the only operational plankton indicator for the pelagic habitats so far is Chlorophyll- a (Chl-a) concentration (Magliozzi et al. 2023 and references there in). The Mediterranean water types, reference conditions and boundaries for Chl-a concentrations were identified in MS coastal waters by the WFD Geographical Intercalibration Group (Commission Decision (EU) 2018/229) Although there have been several studies at the sub-regional or local levels in which diverse indicators were tested, there are still several constraints that prevent an operational use of these indicators. Some of the indicators' groups have been proposed for further testing, such as size-related metrics (the multimetric index of size spectra sensitivity ISS-phyto -Vadrucci et al., 2013), diversity and dominance metrics (Cozzoli et al., 2017) and metrics based on bloom frequency (Facca et al., 2014) to measure the dominance of a species during an algal bloom. In the case of studies at the sub-regional or local level, it is important to consider that the results obtained may be a consequence of adaptation to the specific ecological characteristics of the studied site. Therefore, the results and conclusions should not be extrapolated to a larger scale or other regions without a preliminary study confirming or refuting their applicability.

31. Monitoring and assessing phytoplankton and zooplankton communities can be a challenging task. Issues of concern include:

- the need for harmonization/ standardization of sampling devices, lab methods, strategies with a more uniform and consistent sampling frequency across CPs;

- plankton dynamics and heterogeneity of its distribution at distinct scales of observation
- data qualification for times series
- establish a centralized data depository for FAIR data that can be assessed by all CPs
- consistent data in space and time leading to use statistical methods with no uncertainties in indicator computation
- incorporate new methods and identify new tools for the observation, analysis, assessment of communities such as satellite derived products (ocean color products for Chlorophyll a concentration and Phytoplankton Functional Types), DNA metabarcoding for biodiversity communities' assessment;
- use of field instruments with online transmission of data for real time monitoring;
- integrate data from long-term ecological research (LTER) stations with data from regional monitoring stations.

5. Recommendations

Taking into consideration the above information, the BWG proposes to adopt the following operational objectives and indicators for the implementation of Ecological Objective 1 on Pelagic Habitats (Table 3). Phytoplankton and zooplankton abundance, biomass, communities' composition, functional groups provide good means to identify changes in key groups at the plankton community level. On the other hand, GES and Targets will be discussed during the next WG meetings for a proposal for CORMON Biodiversity and Fisheries.

Table 3

Ecological Objective 1 (EO1): **EO1 Biological diversity:** Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic and climatic conditions	
Operational objective	**Indicator**
The habitat type, including its biotic and abiotic structure and its functions, is not adversely affected due to anthropogenic pressures (e.g. typical species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species). Pelagic broad habitat types (variable salinity, coastal, shelf and oceanic/beyond shelf), if present in the region or subregion: 1.other habitat types could be defined by MS for the MSFD; 2. The typology of pelagic habitats represents a general framework that can be adapted and modified by CPs to integrate local ecosystems features and dynamics	**CI2**: Condition of the habitat's typical species and communities Proposed parameters to be monitored for the development of indices: • Abundance of Phytoplankton and Zooplankton • Biomass of Phytoplankton and Zooplankton • Taxonomic compositton at a certain level (species, genera, groups) • Functional groups of Phytoplankton and Zooplankton

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