



Baltic Marine Environment Protection Commission

Working Group on the State of the Environment and Nature
Conservation

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Background

The Diatom/Dinoflagellate Index was used as a “test indicator” in the Eastern Gotland Basin in HOLAS II. Furthermore, Germany applied the indicator in its MSFD article 8 assessment in the Western Baltic Sea. STATE & CONSERVATION 14-2021 noted that Germany would like to keep the Diatom-Dinoflagellate Index indicator and invited the CPs to clarify their positions on the indicator, following the submission of the document on the diatom/dinoflagellate indicator, at STATE & CONSERVATION 15-2021.

STATE & CONSERVATION 14-2021 invited PEG to provide an elaboration of the diatom/dinoflagellate indicator, explaining how the indicator functions, the rationale behind the methodology and threshold values, data requirements and outlining the explanatory power of the indicator and to provide this to STATE & CONSERVATION 16-2021 for further consideration.

The indicator concept was discussed by PEG and the group realized that the basic indicator concept is still valid but a number of aspects need further development and that it will not be possible to have a fully revised indicator concept ready for HOLAS III. PEG therefore suggests to further develop the indicator for selected Baltic Sea basins and submit a “test indicator” for HOLAS III. This could constitute the basis to further develop the indicator into a core indicator for HOLAS IV. Important shortcomings of the indicator concept and aspects for further development are described in this document.

Action requested

The Meeting is invited to consider the suggested approach and endorse including the Diatom/Dinoflagellate Index as a test indicator for HOLAS III.

Diatom/Dinoflagellate Index – proposal of a test indicator for HOLAS III

Indicator name
Diatom/Dinoflagellate Index
Scale of assessment for HOLAS III and rational
The test indicator will include the open sea basins as well as the outer coastal waters. Further refinements of the scale of the assessment might be needed. The proposed test indicator will focus on the Western Baltic Sea (Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin, Pomeranian Bight) but will incorporate additional basins as far as adequate data and test results are available (Gdańsk Basin, Gulf of Finland).
Spatial coverage of the indicator for HOLAS III
Although the proposed test indicator will focus on the Western Baltic Sea (Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin, Pomeranian Bight), further refinements of the spatial coverage might be needed. Basins with a large extend of anoxic bottom areas (Bornholm Basin) might need to be excluded from the assessment. It is likely that different indicator concepts are required for different basins.
Methodology to be applied for HOLAS III and rational
<p>The Diatom/Dinoflagellate index (Dia/Dino index) reflects the dominance patterns in the phytoplankton spring bloom. It has high relevance for the pathway of the food into the pelagic or benthic food web and can be used as an indicator for the condition of pelagic habitats and as a food web indicator. The indicator rationale is that a high Dia/Dino index indicates healthy benthic food webs, while dinoflagellate dominance (low Dia/Dino index) does not. Diatom dominated blooms settle to the sea floor and feed benthic fauna (=good status), while dinoflagellate dominated blooms disintegrate in the water column or form resting cysts that are not accessible as a food source. This basic indicator concept is described in detail in Wasmund et al. 2017a and b.</p> <p>Since the publications of Wasmund et al. several shortcomings in the indicator rationale became apparent. While diatom dominance supports food supply to benthic fauna in well oxygenated shallow areas, the relationship is not straightforward in deeper areas of the central basins. In many areas of the Baltic Sea where the indicator is used, diatom sedimentation leads to oxygen consumption (due to high amounts of settling biomass), enhancing bottom anoxia which prevents the flourishing of benthic communities. This aspect needs to be considered in a revision of the indicator rationale.</p> <p>Furthermore, there is little evidence available yet, that dinoflagellate dominance leads to a different pathway of production compared to diatoms (retention in water column due to rapid mineralization by a microbial food web - via microzooplankton/<i>Mesodinium rubrum</i>). The rationale as presented in Wasmund et al (2017a,b) probably holds for the southern/western parts of the Baltic Sea but the central assessment regions function differently. Large parts of the produced dinoflagellate biomass is dominated by phototrophic cyst formers (<i>Peridiniella catenata</i>, <i>Biecheleria baltica</i>, <i>Gymnodinium corollarium</i>) and “escapes” the microbial food web. In central parts <i>Mesodinium rubrum</i>, a ciliate, dominates the spring bloom and dinoflagellates or diatoms are of minor importance in the pelagic food web. Also, the role of climate change and associated alterations of the succession patterns are unclear and need further investigation.</p> <p>In general, data availability for the spring season is an issue in some areas (e.g. Eastern and Northern Baltic Sea basins), with difficulties to measure the maximum of the bloom and maximum silica data for the winter period. The availability of historical data to determine GES is regionally patchy, so GES must be determined using alternative methods yet to be developed. It is also</p>

necessary to establish specific interpretations of the respective dia-dino ratios adapted to the respective marine regions. In order to be able to achieve a classification here, further investigation methods are to be used.

It is suggested to address these shortcomings in the general indicator rationale by further developing the indicator and presenting results to STATE & CONSERVATION 16.

References:

Wasmund, N., Kownacka, J., Göbel, J., Jaanus, A., Johansen, M., Jurgensone, I., Lehtinen, S., Powilleit, M. (2017a): The diatom/dinoflagellate index as an indicator of ecosystem changes in the Baltic Sea. 1. Principle and handling instruction. *Frontiers in Marine Science* 4 (22): 1-13.

Wasmund, N. (2017b): The diatom/dinoflagellate index as an indicator of ecosystem changes in the Baltic Sea. 2. Historical data for use in determination of good environmental status. *Frontiers in Marine Science* 4 (153): 1-12.

Threshold value setting logic and rationale

The rationale for threshold value setting has so far been that a high Dia/Dino index was the reference status (Wasmund et al. 2017a,b). Data supporting this hypothesis are, however, limited and many assessment regions lack historic data. To substantiate the threshold value setting rationale sediment archive studies and paleo-ecology approaches need to be taken into account when further developing this indicator. Conducting eDNA based analyses of past phytoplankton communities is also planned in the next years: HELCOM STATE & CONSERVATION as well as PEG are involved in respective investigations of the international Germany-funded Leibniz research project PHYTOARK. Furthermore, in areas with high nutrient loading excessive diatom growth leads to a deterioration of water quality and can therefore not be regarded as good status. It needs to be further investigated whether and how such areas could be considered in the assessment.

Refinements in the threshold value setting logic and rationale will be presented to STATE & CONSERVATION 16.

Threshold value(s)

Refined threshold values for selected assessment areas will be proposed to STATE & CONSERVATION 16.

Other significant issues that need to be addressed or presented to State and Conservation

Although major changes are required concerning the indicator concept and threshold value setting rationale the indicator is still considered important for the assessment of pelagic habitat conditions. Currently, very few plankton indicators exist for such an assessment and all viable approaches need to be further explored. Furthermore, OSPAR is also assessing Diatom/Dinoflagellate ratios in its lifeform pair approach (PH1/FW5) and the aim is to harmonise assessment approach across regional seas as far as possible to fulfill the obligations of the Marine Strategy Framework Directive.

Indicator test results are available for a number of Baltic Sea areas (Finish coastal waters, Gdańsk Basin, Gulf of Riga) and knowledge gained from these areas is shared in PEG and can be used to further develop the indicator.

Latest indicator report or (for new indicators) initially completed indicator template

<https://helcom.fi/wp-content/uploads/2019/08/Diatom-Dinoflagellate-index-HELCOM-pre-core-indicator-2018.pdf>