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Background

The 2nd holistic assessment of HELCOM (HOLAS II) has assessed a large number of themes (including pressures such as eutrophication and biodiversity e.g. of pelagic and benthic habitats) with suitable indicators. While linkages between indicators within a respective theme have already been partly taken into account (especially where they were part of a conceptual assessment framework), linkages across themes have not been considered and are poorly understood. An ecosystem-based approach to the management of human activities requires an understanding and interpretation of those linkages to arrive at a truly holistic assessment. Therefore, the aim for HOLAS III and beyond should be to further develop this understanding.

One of the aims of the 2nd HELCOM indicator workshop is to gain clarity of how indicators will be used in HOLAS III. This includes a discussion of linkages of indicators within and across themes and integrated assessments including the comparability/compatibility of indicator assessments (threshold values) across themes and pressure-state linkages. A first step addressing this task is the identification of relevant linkages that should be discussed further. To contribute to this subject IN Eutrophication has prepared an example for such an analysis focusing on linkages that are relevant for eutrophication. This analysis is based on comparing themes and indicators used in the HOLAS II assessment but does not involve at this stage a more in-depth analysis considering further scientific literature. Such an analysis is potentially necessary as a second step to consolidate the questions that are raised in this document.

For improving the linkages in HOLAS III and beyond it could, in some cases, be sufficient to add explanatory text to the assessments, while in other cases further scientific work might be required, e.g. to align target values.

Action requested

The Workshop is invited to:

- discuss, verify the relevance, and suggest a potential priority related to which linkages are most significant
- suggest further work to better understand and explain prioritized linkages

Improving linkages within and across themes in HOLAS III – An example focusing on aspects related to eutrophication

Identification of linkages within the theme eutrophication in need for improvement

The HEAT 3.0 tool that was applied in HOLAS II to assess eutrophication is based on our current conceptual understanding of eutrophication processes in the marine environment. Eutrophication is caused by high nutrient inputs leading to high nutrient concentrations as causative factors. High nutrient concentrations lead to direct eutrophication effects that develop after a short time. When high nutrient concentrations persist for longer and as a consequence of direct effects, indirect effects develop, often indicating chronic eutrophication. The HEAT 3.0 assessment tool follows this conceptual understanding of eutrophication by assessing nutrient levels, direct and indirect effects of eutrophication. As such, the assessment tool already acknowledges relevant linkages between the indicators.

Nevertheless, there are a number of open questions that arise when comparing the assessment results for different eutrophication aspects. Although the whole open Baltic Sea has been assessed as eutrophied, the maximum allowable nutrient inputs have already been achieved in the Kattegat and Danish Straits. This discrepancy needs further explanation in HOLAS III. Some possible reasons are already known and include nutrient exchange processes between basins, different spatial scales used for the assessment a well as potentially also methodological weaknesses in deriving nutrient reduction targets for the Western Baltic Sea.

With successes in reducing nutrient inputs it would be expected that the nutrient levels, followed by the direct effects, reach good status first and that there is a substantial time delay until good status is achieved for the indirect effects, since these are mediated by complex interactions in the ecosystem and their recovery is slow. However, for the HOLAS II assessment results the opposite is true. Nutrient levels are furthest away from good status, direct effects are moderately away from good status and for indirect effects parts the Bothnian Sea and Bothnian Bay already reach good status. The reason for this discrepancy is possibly that the threshold values of nutrient levels, direct effects and indirect effects are not well aligned. This is especially true for the indicator “state of the soft bottom macrofauna community” that does not seem to reflect eutrophication effects well enough (see below). Another reason could be that the recovery trajectories of the eutrophied Baltic Sea are not yet well understood.

Lastly, there are also spatial discrepancies in the eutrophication assessment of HOLAS II. In some coastal areas nutrient levels already reach good status while further offshore the status is not good. While this could be explained by nutrient sources that do not come from land (e.g. shipping, transboundary nutrient transports, nutrient resuspension from the sediments) it is most likely due to discrepancies in target values used in coastal waters and the open sea.

Identification of linkages of the theme eutrophication with other themes that require improvement

Assessment of benthic habitats

HOLAS II has only assessed the state of soft-bottom macrofauna communities by using the “Benthic Quality Index. The BQI, which assesses the diversity and sensitivity of benthic communities, should react to organic enrichment and thereby indicate eutrophication, but is also reacting to other pressures (e.g. physical

disturbance due to e.g. fishing). There are discrepancies between the assessment of eutrophication and benthic habitats in HOLAS II. In fact, while the whole open Baltic Sea is eutrophied and oxygen depletion is wide-spread the state of the soft-bottom macrofauna communities is predominantly good. This discrepancy warrants further investigation. One reason could be that the BQI is only applied in shallower waters while the oxygen debt indicator is applied in the deep basins, but this information is not obvious in the HOLAS II assessment. Concerning the future development of benthic indicators the aim should be that such indicators can differentiate between the eutrophication pressure and the pressure from physical disturbance of the seafloor. In practice, such a differentiation could prove challenging.

Currently, there is no common indicator on macrophytes that has been applied in HOLAS II. The future development of macrophyte indicators, especially where it is related to looking at depth limits, should take the target values for secchi depth into account and should investigate what depth limit for macrophytes they permit.

Assessment of pelagic habitats

There are numerous direct relationships between the eutrophication status and the status of pelagic habitats, since phyto- and zooplankton populations directly react to high nutrient concentrations. Arguably, pelagic habitats in eutrophied areas of the Baltic Sea should not achieve good status. However, besides eutrophication there are other pressures that influence pelagic habitats, most importantly climate change and possibly also non-indigenous species. Food-web processes are also decisive in this respect. The development of indicators for pelagic habitats is still in progress. HOLAS II has used indicators that were also used in the eutrophication assessment (cyanobacterial blooms, chlorophyll-a) as well as the indicators “zooplankton mean size and total stock” and “diatom/dinoflagellate index” that react to eutrophication, but also to climate change and food-web mediated processes. In fact, for the zooplankton indicator there are two different threshold values available, of which only one takes Chlorophyll-a (and eutrophication) into account. A future assessment framework for pelagic habitats should be as much as possible capable of separating the different most relevant anthropogenic pressures that lead to a failure of good status for these habitats. Furthermore, it needs to be carefully decided whether the zooplankton and phytoplankton indicators should be used for an assessment of pelagic habitats, food webs or eutrophication.

Assessment of coastal fishes

There are various bottom-up and top-down food-web mediated relationships between eutrophication and the abundance of coastal fishes. In particular the abundance of cyprinids is often increased in eutrophied areas. Cyprinids are assessed as part of the coastal fish indicator and a reflection is needed whether a Baltic Sea in good eutrophication status will also allow the achievement of good status of coastal fish populations.

Assessment of waterbirds

Eutrophied marine ecosystems could provide more food for waterbirds compared to ecosystems that are in good status with respect to eutrophication. Concerning HOLAS II in particular waterbirds in the wintering season were in good status in many areas of the Baltic Sea and it needs to be investigated whether in these cases abundances of waterbirds are kept high due to eutrophication and whether these bird populations would still achieve good status if eutrophication is reduced.