Changes in Phytoplankton and Zooplankton Communities

MSFD Descriptors: 1 - Biological diversity; 4 - Marine food webs

MSFD Criteria: 1.4 - Habitat distribution; 1.6 - Habitat condition; 4.3 - Abundance/distribution of key trophic groups/species

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Key Message Plankton form the base of the marine food web and respond rapidly to environmental change, making them important indicators of ecosystem state. Between 2004-2014 Plankton communities experienced significant changes in relative abundance, indicating alterations to aspects of ecosystem functioning. The changes are widely accepted to be linked to prevailing conditions and may be driven by climate change, nutrient enrichment or other factors

Background

Plankton (microscopic algae and animals) form the base of the marine food web, making them important indicators for ecosystem state. Changes in plankton communities can affect higher food web levels, such as shellfish, fish and seabirds, since these organisms are supported either directly or indirectly by plankton. Indicators based on plankton lifeforms (i.e. organisms with the same functional traits; **Figure 1**) can be used to reveal plankton community responses to factors such as nutrient loading from human activities and climate-driven change. When examined in pairs with an ecologically-relevant relationship (**Figure 1**) changes in the relative abundance of two lifeforms together (called a lifeform pair) can indicate change in key aspects of ecosystem function, including links between pelagic and benthic communities, energy flows and pathways, and food web interactions. For example, changes in the phytoplankton (algae plankton) lifeform can cause changes in the zooplankton (animal plankton) lifeform that feeds on them. At the North-East Atlantic regional scale, plankton community change is strongly linked to prevailing climatic conditions. Pelagic habitats, which are defined based on key water column features, are important to plankton community structure and dynamics (**Figure 2**).

Because this is a new Indicator Assessment in the first phase of development, no assessment value exists. Instead, the years 2004 to 2008 are used as compared to the last 6-year period (2009 to 2014) to examine changes in lifeform pairs.

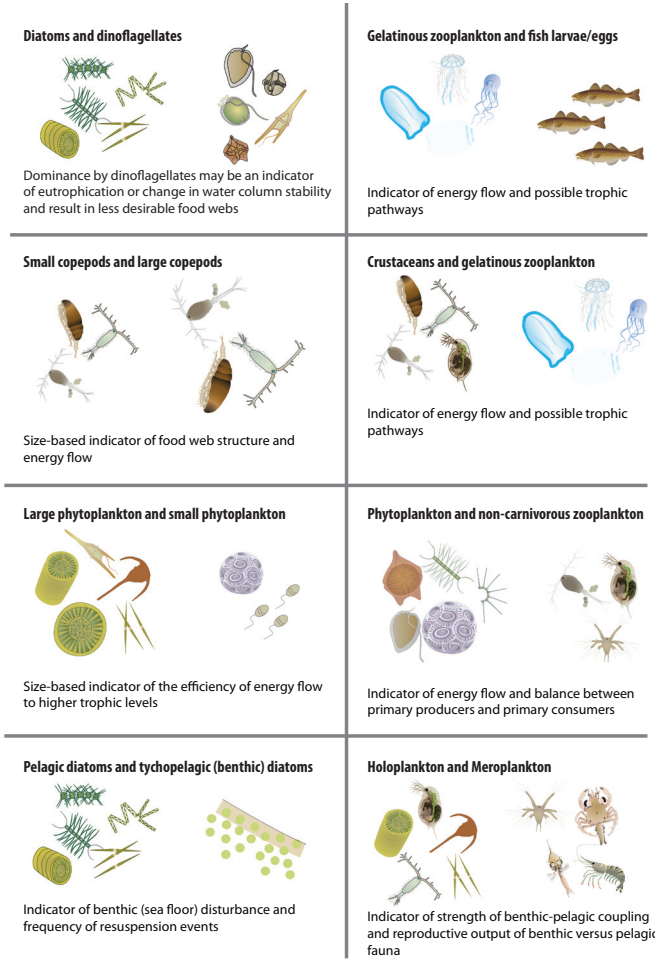

Figure 1: Plankton lifeform pairs and ecological rationale for their selection

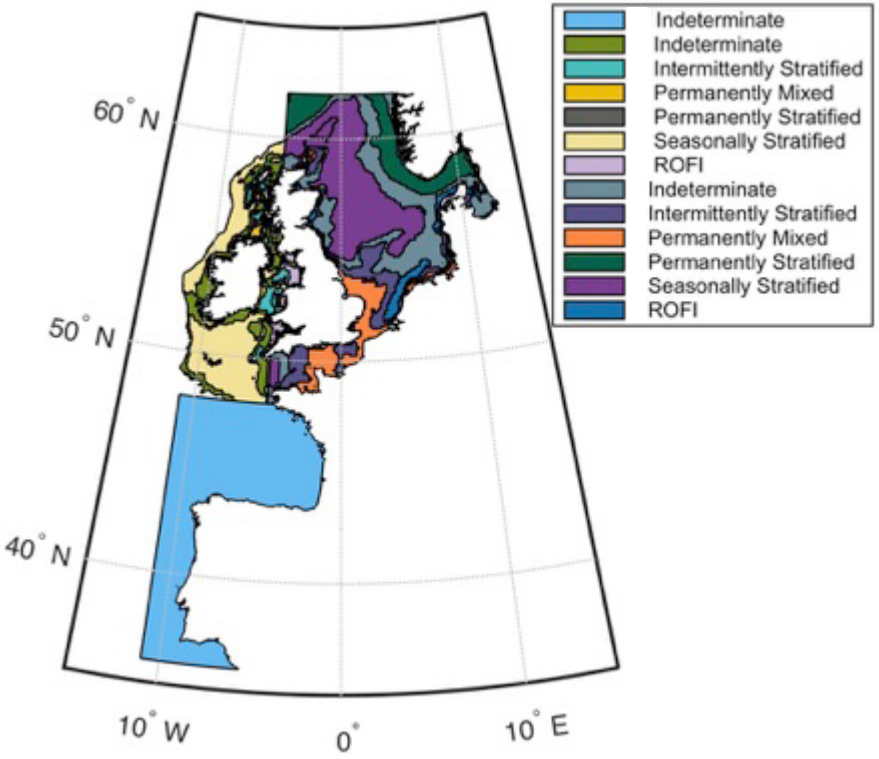

Figure 2: Ecohydrodynamic zones (EHDs) in the Greater North Sea, Celtic Seas, and Bay of Biscay and Iberian Coast

Ecohydrodynamic zones (EHDs) are constructed based on key water column features, which are important to plankton community structure and dynamics. Based on water column structure, there are six predominant EHD are types: permanently mixed throughout the year; permanently stratified throughout the year; regions of freshwater influence (ROFIs); seasonally stratified (for about half the year, including summer); intermittently stratified, and; indeterminate regions (inconsistently alternate between the above levels of stratification). Work is on-going to define echohydrodynamic zones in the Bay of Biscay and Iberian Coast

Changes in Phytoplankton and Zooplankton Communities

Results

This assessment reveals change in North-East Atlantic plankton communities between the periods 2004–2008 and 2009–2014. Although lifeform pairs exhibited significant change in some areas of the North-East Atlantic (**Figure 3**), this does not necessarily imply deterioration of environmental conditions.

The 'holoplankton and meroplankton' lifeform pair experienced significant change in most areas, suggesting changes in linkage between the benthic and pelagic components of the ecosystem. Changes have also occurred in the 'small copepod and large copepod' lifeform pair in many areas, which could indicate possible alterations to food web structure and energy flows. The 'pelagic and tychopelagic' (benthic) diatom lifeform pair only underwent significant change in a few areas, which could indicate no important changes in resuspension events in much of the North-East Atlantic.

It is not currently possible to link the changes in lifeform pairs to any particular human pressures, or to link these changes to other biodiversity Indicator Assessments.

The methods and data for this indicator are considered to be of moderate confidence.

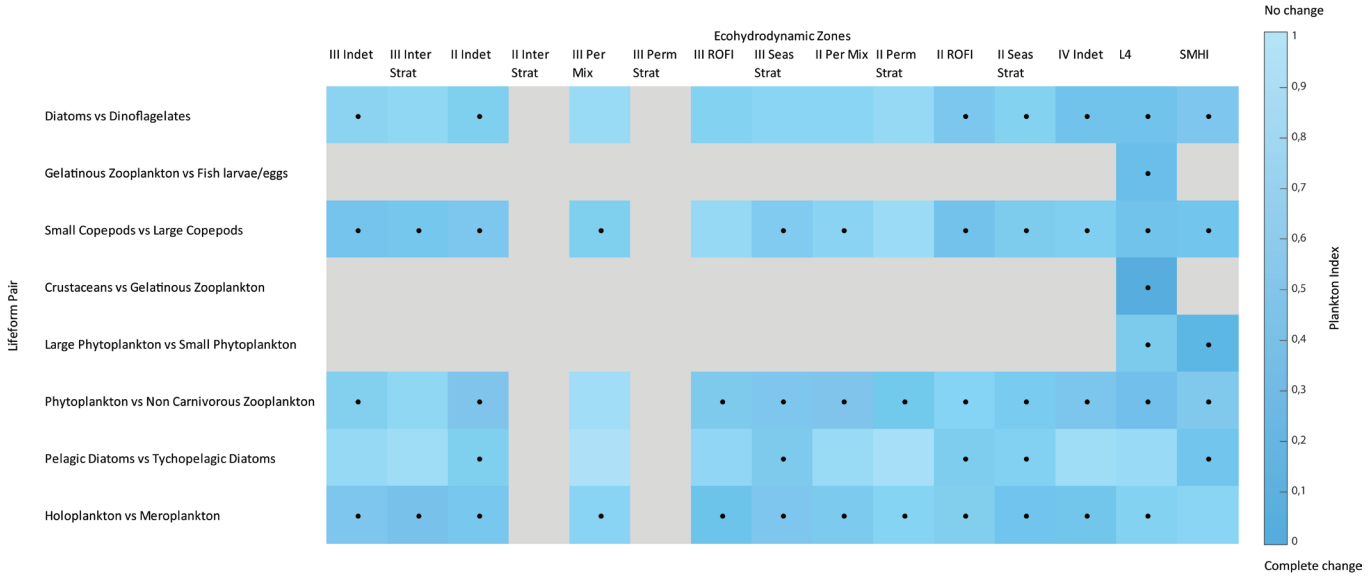

Figure 3: Change in Plankton Index between the periods 2004–2008 and 2009–2014 for each lifeform pair

Darker blue indicates a more pronounced change. Grey shading represents where there were not enough / well-represented data to determine a Plankton Index. Cells with dots indicate significant change (p<0.01) since the period 2004–2008. Changes in the Plankton Index do not necessarily indicate a deterioration of environmental conditions. They do, however, indicate change from starting conditions

Conclusion

This assessment indicates that there is variability in the plankton community for all lifeforms, which is in accordance with the published scientific literature on plankton dynamics.

While the indicator assessment shows there is change, further work is needed to draw conclusions on the magnitude, direction and the key pressures or environmental factors driving change in lifeform pairs. Interpretation of the results and further refinement of the methodology have still to take place. An extensive peer-reviewed research base, however, suggests that prevailing oceanographic and climatic conditions are the overall driver of plankton change in the North-East Atlantic.

Knowledge Gaps

Further scientific research is needed to examine the magnitude and direction of change in the Plankton Index with respect to each lifeform pair, as well as the ecological consequences of such change, for each lifeform pair in each ecohydrodynamic zone. It is also necessary to investigate links between change in lifeform pairs and human and climatic pressures. If changes due to prevailing conditions (such as natural variability and climate change) can be separated from those caused by human pressures in each region, this will help to inform management decision-making by allowing the application of regionally-targeted management measures only where needed.

This document was published as part of OSPAR's Intermediate Assessment 2017.

The full assessment can be found at www.ospar.org/assessments