Pilot Assessment of Production of Phytoplankton

MSFD Descriptor: 4 - Marine food webs
MSFD Criterion: 4.1 - Productivity (production per unit biomass) of key species or trophic groups

OSPAR COMMISSION

Key Message This pilot assessment examines how the primary production of phytoplankton changes over time. The results show site-specific changes, but do not allow a generalised conclusion across OSPAR regions with the current dataset. In future this indicator could help understand effects of management measures and provide information on the dynamics of primary production, which is key to sustaining marine food webs

Background

Phytoplankton comprises photosynthetic plant-like microscopic organisms. The two major groups in coastal systems are diatoms and dinoflagellates. Phytoplankton primary production is fundamental to the marine ecosystem and represents the first available flow of energy through the ecosystem (**Figure 1**). Phytoplankton primary production (i.e. organic matter formation) can be measured in situ using oxygen and carbon dioxide tracers or various fluorometric techniques.

Phytoplankton primary production is affected by various pressures, including nutrient enrichment, light availability, grazing pressure, contaminants, hydrodynamics and climate change. Phytoplankton primary production is useful as an indicator of pressures on the marine food web. The ability of an ecosystem to recover from disturbance is a complex process; information on phytoplankton primary production, together with pelagic habitats indicators (e.g. plankton biomass, abundance and diversity) can help understanding of this process. There is currently no coordinated monitoring in the North-East Atlantic for phytoplankton primary production. This indicator is in development and the current assessment is a demonstration of how it could work, using available data.

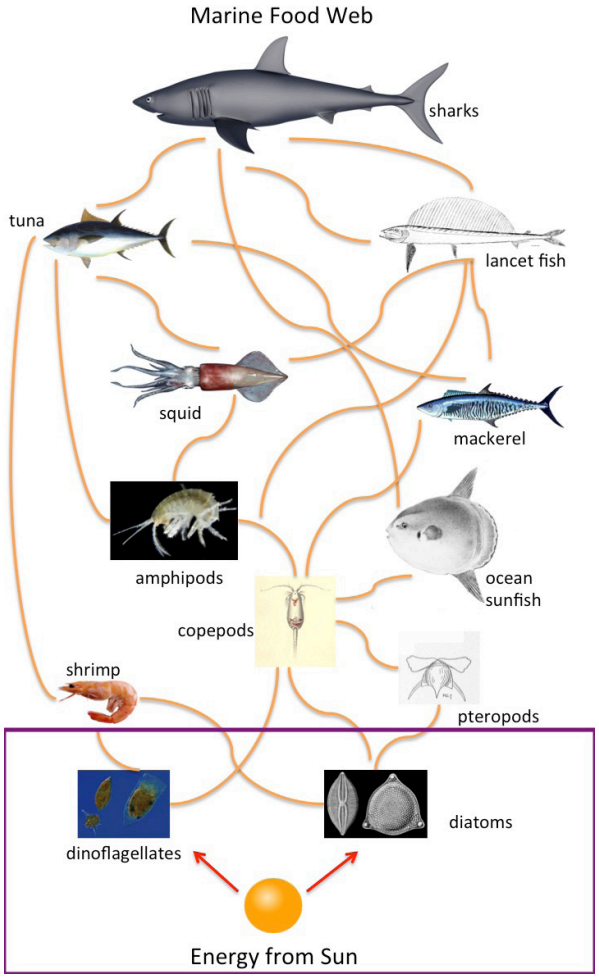

Figure 1 (left): Representation of a marine food web (purple box represents phytoplankton primary production)

Figure 2 (right): Map showing the location of the study sites. OMEX: Ocean Margin Exchange (OMEX) project

Results

Measurements from several study sites (**Figure 2**) were analysed and used to support this pilot indicator assessment. For each one, the variations in annual primary production (APP) can be observed over time.

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Results cont...

The results for the nine survey sites that were analysed in this pilot assessment are outlined below (**Table 1)**.

The difference between the natural variability of a stable state and a change of state was investigated through statistical analysis. The link between the variation in trend, whether it is increasing or decreasing, and pressures on the ecosystem cannot be generalised across the sites included in this pilot assessment.

Study site		Results
North Sea		The ecohydrodynamic region UNC (unclassified for water column stratification) showed a decreasing trend in annual phytoplankton production from the start of the time series (1988-2013); it is not yet clear what is causing these changes.
Skaggerak Coast		Between 1985 and 2012, the long-term trend of primary production declined, however a tendency for increased rates from 1992 to 1996 can be observed.
Sylt-Rømø Bight (Germany, Denmark)		Over the period 1994-2014, no trend can be observed and pressure from human activity has little impact on primary production.
Central and Western English Channel	Portsmouth-Ouistreham transects	The annual estimations (coastal and offshore) show a decreasing gradient in primary production from the French coast to offshore, which could be induced by the coastal nutrient inputs from the Seine river.
	Baie des Veys	The annual estimations show a high coastal primary production linked to the estuarine nutrient inputs, which in turn support shellfish farming activity.
	Roscoff-Plymouth transects	Comparing the offshore annual estimations of both transects (Portsmouth-Ouistreham and Roscoff-Plymouth) shows an interannual offshore stability allowing characterisation of these offshore hydrodynamic zones (i.e. water masses).
Western English Channel Plymouth L4 Station		Over the period 2003-2010, no trend can be observed.
Celtic Sea Shelf Break		Annual estimation only available for 2001.
Liverpool Bay		Over the period 2003-2009, no trend can be observed.

Table 1: Summary of results concerning annual primary production for the various study sites. APP: Annual Primary Production (phytoplankton production)

Conclusion

This pilot assessment shows site-specific changes, however the current dataset does not allow a generalised conclusion across OSPAR regions. This assessment illustrates the potential for the indicator to show changes in phytoplankton primary production and provides key information on the dynamics of primary production. This pilot assessment also demonstrates interannual variability within study sites and variability between them. This indicates the importance of collecting enough years of data to understand the range in variability and the likely causes. Furthermore, phytoplankton primary production in coastal waters shows higher variability than in offshore areas and so needs monitoring at a higher frequency than in offshore areas in order to detect trends. Long-term monitoring in offshore zones should provide answers on more fundamental changes in ecosystems functioning because they are less subject to local variations (e.g. through nutrient inputs).

Based on the case studies presented, it appears that this indicator can contribute to a broader assessment. The first assessment carried out can also provide a baseline for further assessments. Different methods, sampling strategy and sampling design can support the further development of the assessment. This process allows flexibility for Contracting Parties to have differing monitoring programmes but still provide a coordinated assessment.

A more coordinated approach to spatial and temporal monitoring (sampling strategy) is necessary for a full assessment of this indicator. The European Union funded project EcApRHA resulted in a large amount of methodological development and scenarios to improve monitoring, enhancing the indicator's development.

Knowledge Gaps

The relationship between pressures and phytoplankton primary production is not completely clear and should be evaluated in conjunction with other indicators and expert judgement.

The range in natural variations and assessment values for phytoplankton primary production require further study.

To define the assessment scales, hydrodynamic regions could be used, however this needs further validation for this phytoplankton primary production indicator.

The pilot allowed gaps to be addressed within what is planned under existing national monitoring in the near future without any further coordination. However, in order to progress to delivering a full assessment in the next cycle, there is a need for a consistent monitoring strategy to be developed taking into account the techniques available for phytoplankton primary production assessments. The EcApRHA project helped in proposing different scenarios for optimised monitoring.

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

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