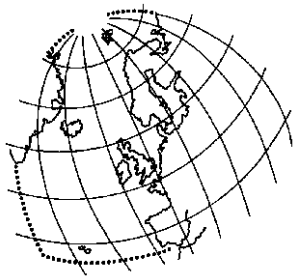

JAMP Eutrophication Monitoring Guidelines: Phytoplankton Species Composition

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1. Introduction

Phytoplankton species composition serves as an indicator of the effects of eutrophication. Nutrient enrichment/eutrophication may give rise to shifts in phytoplankton species composition (*e.g.* from diatoms to flagellates, some of which are nuisance or toxic) and an increase in the frequency and/or magnitude and/or duration of phytoplankton blooms and/or of nuisance/potentially toxic blooms. These guidelines are intended to support the minimum monitoring requirements of the Nutrient Monitoring Programme[1].

2. Purposes

The measurement of phytoplankton species composition is carried out for, *inter alia*, the following purposes:

1. to establish the spatial distribution and frequency of phytoplankton blooms;
2. to establish temporal trends, over periods of several years, in phytoplankton species composition and their relative abundance;
3. to identify key phytoplankton species.

3. Quantitative objectives

[Secretariat note: in addition to the general purpose of the programme, an explicit quantified statistically formulated objective for temporal trend and spatial distribution monitoring requires development.]

4. Sampling strategy

An understanding of the complexity of the hydrography of estuarine or coastal seas is necessary before starting to survey or sample the phytoplankton. Thus, there is a need for routine hydrographic observations at the same time as the surveys/sampling. Apart from the influence of water column structure on phytoplankton dynamics there is a need to consider horizontal (spatial) and temporal variability in order to establish the frequency and location of sampling. Sample sites should be further apart than the horizontal tidal amplitude but sufficiently close to resolve the presence of strong gradients. Sampling frequency should take account of seasonal variability in the relative abundance of the species of interest.

The abundance of "key species" should be examined. The "key species" are dominant and/or nuisance and/or potentially toxic species. Examples of species which are dominant and/or nuisance and/or potentially toxic are: *Alexandrium* spp. (*Gonyaulax*), *Ceratium* spp., *Chrysochromulina polylepis, Corymbellus aureus, Coscindiscus wailesii, Dinophysis acuminata, Gymnodinium catenatum, Gyrodinium aureolum, Lepidodinium viride, Noctiluca scintillans, Phaeocystis* spp., *Prorocentrum balticum, Prorocentrum minimum, Prymnesium parvum, Pseudonitzschia* spp. Attempts should be made to establish the overall species composition.

[1] The Nutrient Monitoring Programme as adopted by OSPAR 1995 (OSPAR 95/15/1, Annex 12).

Particulate organic carbon, total organic carbon, particulate organic nitrogen, light (PAR/Secchi depth), temperature and salinity should be measured as supporting/interpretation parameters.

Aerial surveillance (for example under the Bonn Agreement) will help to identify annual and interannual variability in phytoplankton bloom development and will also help target specific sampling in relation to phytoplankton bloom events. Short synoptic surveys may be useful for following the dynamics of phytoplankton blooms within a growth season, *e.g.* by helicopter.

5. Sampling equipment

Techniques for sampling are various. Nets are limited in that they do not retain all phytoplankton but can concentrate from a large volume and are helpful for determining the species composition. Nets are semi-quantitative if used with a flow meter attached. Water bottles sample discrete and smaller volumes but retain all organisms and are thus necessary for quantitative studies.

6. Storage and pre-treatment of samples

In general, samples are preserved with a suitable fixative such as lugol or formalin[2]. Many small, naked flagellates are destroyed by fixatives and can only be identified live.

7. Analytical procedures

Microscopic analysis allows direct identification of phytoplankton species and quantification in terms of cell numbers. Many small (<5 μm) cells will be very difficult to identify by light microscopy and may have to be recorded as unidentified. The counting procedure should be based on the proposals of ICES (1996). Given the rapid development of flow cytometry and the large number of small fluorescent cells present in samples, these are best determined by fluorescence microscopy or flow cytometry. A combination of flow cytometry and immuno-labelling may in the near future enable the rapid and conclusive identification and counting of toxic species if sufficient immuno-labels are available. New methods may offer the opportunity for fast-automated analysis of phytoplankton species samples.

8. Analytical quality assurance[3]

The quality assurance programme should ensure that the data are fit for the purpose for which they have been collected, *i.e.* that they satisfy the objectives of the monitoring programme. Emphasis should be placed on the intercalibration of species identification on a regular basis. A phytoplankton checklist must be compiled during intercalibration exercises.

9. Reporting requirements

[Secretariat note: reporting procedures require development. As a component of the 1997 ICES Work Programme, the Oslo and Paris Commissions have formally requested ICES to establish a databank for phytoplankton species. The work will include the development of a reporting

[2] Recommendation on the fixative to be used should be updated on the basis of the outcome of a suitable calibration exercise.

[3] A joint ICES/OSPAR Steering Group on Quality Assurance of Biological Measurements related to eutrophication parameters was established in 1997 in order to coordinate the development of quality assurance procedures, the implementation of quality assurance activities (*e.g.*, the conduct of workshops and intercomparison exercises) and the preparation of appropriate taxonomic lists of species. This work will cover phytoplankton species and is a fairly long-term programme of about five years. Good cooperation will be ensured with the ICES/HELCOM steering group on Quality Assurance of Biological Measurements in the Baltic Sea.

format and a species code list. The reporting procedures should include a national report containing information on methods used and any other comments or information relevant to an ultimate assessment of the data. In order to establish the acceptability of the data, they should be reported together with the dates and results of participation in intercalibration exercises.]

10. References

ICES (1996). Report of the ICES/HELCOM Second workshop on quality assurance of biological measurements in the Baltic Sea, Warnemünde, Germany, 16-20 September 1995. ICES CM 1996/E:1.