Oceanography Committee

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Report of the

Working Group on Phytoplankton Ecology

Villafranche-sur-mer, France
11–13 March 2003

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 EXECUTIVE SUMMARY

The meeting was held at Laboratoire d'Oceanographie de Villefranche, France, between 11 and 13 March 2003. Six members representing six ICES countries attended the meeting.

The reports of SGQAB/SGQAE were reviewed and it was underlined that the work of SGQAB and SGQAE continues to be of relevance to the members of the WGPE. Due to the lack of the SGQAB report, WGPE could thus only take note of the SGQAB agenda. Some of the agenda items were discussed under WGPE ToRs b and g. Concerning the review of the comments and adoption of the changes made to the COMBINE the WGPE could not find any changes on phytoplankton and chlorophyll a sections. SGQAE mentioned in its report the international workshop on contrasting approaches to understanding eutrophication effects on phytoplankton at The Hague in March 2002. The aim of compiling an annual phytoplankton report similar to that of WGZE was noted by SGQAE with appreciation. A report with plankton research and monitoring would then be available. The WGPE took note of the presentation of ICES data reporting formats, which will be used for the next 10 years. ICES will not accept spreadsheets since there are significant problems with cell formatting that affects the number of decimal places. Since ICES are planning on a 'modern' format (XML) in a few years, many countries are waiting for the newer format rather than spending resources on developing routines to write ASCII output. If ICES does not solve these problems, there is a significant risk that other organisations will develop their own systems rather than use the established ICES system. Concerning the standard method of chlorophyll measurements, the WGPE is missing a review, discussion and evaluation of the Chlorophyll standard method, which was prepared by Aminot and Ray some years ago. It is now published in ICES Time Series 38.2002. Concerning phytoplankton it was found that a standardisation is much needed. The Netherlands has developed a standard by now and this will be used as a model for the German standard. CEN also developed a draft of a standard method for phytoplankton analysis. As for chlorophyll there seems to be several parallel initiatives. It would seem appropriate to gather these initiatives to one within the WFD. WGPE stressed the importance of intercomparisons and ring tests for phytoplankton. In some countries, e.g., France, Germany and the Netherlands participation is mandatory.

The WGPE found the lack of news from the Study Group for Phytoplankton and Protist Taxonomy (SGPPT), formerly the Study Group on a Checklist for Phytoplankton and other Protists (SGPHYT) unsatisfying and discussed ways to solve this problem. A way to get things going is to compile a WGPE checklist, based on the input of available personal, institutional and national checklists. The WGPE decided to compile such a list by 1 October 2003.

The termination of phytoplankton time series continues to be a problem and of great concern for WGPE. Automated systems are obviously taking over the monitoring of the sea. In terms of phytoplankton this is unfortunate, as there is no method of analysing phytoplankton species composition and species abundance this way. Using only automated monitoring will result in a loss of biodiversity information. A lot of the future monitoring will obviously rely on modelling, which however is dependent of real data for validation.

The background for organising a Phytoplankton – Zooplankton Workshop is the detailed discussion between WGPE and WGZE in Bergen, Norway, 2001. The fact that studies to develop detailed information about phytoplankton and zooplankton species are often done independently and as a result insight into the complex interactions between the two groups is usually lacking. It was suggested that a workshop approach might be best in which there was a review of the status and a development of a plan on how to proceed. It was decided to organise a Workshop on modelling phytoplankton-zooplankton to be held in conjunction with the 2004 annual meetings of WGPE.

The first steps towards an annual Phytoplankton Status Report were taken this year. The aim is that all participating countries should compile these reports annually and that they should be merged with the corresponding zooplankton summary status report.

The review of the OSPAR eutrophication status report could not be properly addressed, due to the lack of background documents. However, it was noted that phytoplankton communities are among the elements of Ecological Quality with chlorophyll and phytoplankton indicator species. The WGPE finds it satisfying as they are important parameters to signal the progress of nutrient reduction, although the assessment is not always without problems. The WGPE also see a problem in find proper background levels. The choice of indicator species is also more problematic in marine waters than in fresh water. Increased nutrient concentrations will result in an increased growth of phytoplankton and in some cases of certain species. There may also be a structural change in the phytoplankton community, which may serve as a warning signal.

The WGPE noted that it seems as Primary Production measurements are on its way to disappear in the Baltic Monitoring Programme. This is unfortunate, as it is the only regular rate measurement. The primary production has important links to eutrophication and sedimentation and, consequently, to deep water oxygen concentrations. In order to get an overview of the situation and thoughts about primary production measurements it was decided to circulate a questionnaire to ICES member countries. It will be circulated directly to laboratories/individuals who have participated in recent meetings, requesting that their responses are returned by 1 November, 2003.

The WGPE discussed the decision by ICES to use the Integrated Taxonomic Information System (ITIS). The WGPE noted with surprise that it had not been asked to give its comments on the decision. The WGPE is well aware of the need of a taxonomic coding system and the need of firm rules for the database system. There are, however, a number of open questions, which need to be clarified, and also a number of things that need to be developed before this system is ready for operational work. A simple check of a number of marine phytoplankton species gave a disappointing result, revealing that the list contains numerous mistakes in spelling and taxonomy, as well as the lack of species. Moreover the ITIS list does not seem to be maintained. We found phytoplankton species names in the list that had undergone taxonomic revision and got new names – generic as well as species - before 1995, i.e. more than 8 years ago. The list, if to be used, must be continuously updated, which is a considerable task. This has to be clarified between ICES and ITIS. The way the ITIS list is presented on the web makes it extremely complicated to use. A system of browsing is an absolute minimum of user friendliness. The WGPE also found the coding of species strange and of very little help in sorting species into groups, like diatoms, dinoflagellates etc. The WGPE concludes that there is a strong need for ICES to work on the ITIS list before it can be accepted and used as a helpful tool. Until this is done it will take too much work for individual data providers to manage and adapt their phytoplankton data. Moreover, it will result in considerable double work, which may anyway have to be redone at ICES.

Due to serious problems of funding the participation in ICES Working Groups that are not directly involved in fishery business in Sweden it was decided to appoint a Co-Chair. The WGPE asked Francisco Rey to act as Co-Chair. Francisco accepted this task.

2 WELCOME AND OPENING OF THE MEETING

The ICES Working Group on Phytoplankton Ecology (WGPE) meeting was hosted by Laboratoire d'Oceanographie de Villefranche, France, between 11 and 13 March 2003. Six scientists from 6 countries participated. The list of participants is given in Annex 1. The meeting agenda is presented in Annex 2.

The Chair then outlined the comments and review from the ICES Oceanography Committee. The overall impression of the reviewers was that the 2002 report was good. The recommendations to measure primary production had not been adopted by ACME, as they had not been convinced by the Working Group's arguments. While the Working Group has links to other groups (e.g., WGZE, WGHAB, OSPAR), it would be useful to have attendees from at least the other ICES Working Groups to the WGPE meeting and a joint meeting of WGZE and WGPE was recommended. The Chair, Dr Lars Edler, opened the meeting at 9.30 am. He welcomed the participants to the Working Group meeting. The director of the laboratory, Professor Louis Legendre, welcomed the participants and gave a short presentation of the laboratory. The Chair then started the meeting with a series of announcements, mainly regarding practical details.

The reviewer agreed strongly with the Working Group in stressing concern over the potential termination of the 30-year time series of phytoplankton from Marsdiep in the southern North Sea. The Committee suggested that the WGPE explore the primary production estimates now being estimated routinely from satellite imagery. The Working Group Chair indicated that no one presently in WGPE has such expertise but one will be sought. The Committee Chair stated that in Germany ground truth data on primary production are being collected along ferry routes. The Committee felt this was highly valuable in determining the accuracy of the satellite estimates at high latitudes. The Terms of Reference for 2003 were reviewed and adopted.

3 TERMS OF REFERENCE

At the 90th Statutory Meeting, 2002, in Copenhagen, Denmark, the Council approved the WGPE Terms of Reference for 2003.

The ICES Working Group on Phytoplankton Ecology (WGPE), (Chair: L. Edler, Sweden) will meet in Villefranche sur Mer 11–13 March 2003 to:

a) review the reports of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic and the Steering Group on Quality Assurance of Biological Measurements in the Northeast Atlantic;
b) elaborate the outcome of the work of the Study Group on an ICES/IOC Checklist of Phytoplankton and other Protists;
c) outline the consequences of the potential termination of a unique North Sea phytoplankton 30 year time series from the Marsdiep station in the southern North Sea;

d) organise a Workshop in collaboration with Working Group on Zooplankton Ecology, on modelling phytoplankton-zooplankton interactions;

e) prepare contributions on phytoplankton monitoring for the inclusion in the Summary Report on plankton monitoring results in the ICES area;

f) review reports from OSPAR concerning the eutrophication status of the OSPAR area;

g) consider the HELCOM experience with respect to primary production measurements in environmental monitoring programmes;

h) consider the potential of ITIS as a common taxonomic system within ICES;

4 DISCUSSION OF TERMS OF REFERENCE

4.1 TOR a – Review of the reports of ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic (SGQAB)/ICES/OSPAR Steering Group on Quality Assurance of Biological Measurements in the Northeast Atlantic (SGQAE)

The work of SGQAB and SGQAE continues to be of relevance to the members of the WGPE. Feedback to and from these study groups plays an important role in ensuring relevant expertise is available to the steering groups and that WG members are well informed of developments. Quality assurance issues being addressed represent major interests of the Baltic and North Sea communities.

4.1.1 SGQAB

At the time of the WGPE meeting there was no report or draft from SGQAB available. WGPE could thus only take note of the SGQAB agenda. Important items listed in the agenda were:

Review of the changes made to ICES environmental data reporting formats and the status of data submissions during 2002.

Review of the development of taxonomical checklists for the HELCOM/Baltic Sea area. This item is also a ToR in WGPE. Please refer to ToR b.

Review of the results of the questionnaire on primary production activities and progress in development of primary production reporting formats. Review and report on the changes made to the phytoplankton primary production manual in the COMBINE. *These items are related to ToR g in WGPE. Please refer to ToR g.*

Review and report on the outcome of the activities of the HELCOM phytoplankton expert group. At the 2002 HELCOM PEG meeting in Rostock, Germany, the phytoplankton counting program, 'PhytoWin', was distributed to all the group members. The meeting was also informed of a meeting with Jørgen Nørrevang, ICES, where the ICES-format of Phyto-Win was discussed. Guy Hällfors has updated his comprehensive checklist of Baltic Sea phytoplankton species. The checklist is now available on ICES web-sites and at Alg@line. The complete version can be found at http://jolly.fiMrfi/Virpi/Checklist3.nsf/.

Review of the comments and adoption of the changes made to the COMBINE phytoplankton chlorophyll a manual by the ICES WGPE and experts from HELCOM laboratories. As far as WGPE could see, there has been no changes made to the COMBINE manual concerning phytoplankton and chlorophyll a.

4.1.2 SGQAE

One of the ToRs of SGQAE was to review the 2002 report of WGPE. SGQAE mentioned the international workshop on contrasting approaches to understanding eutrophication effects on phytoplankton at The Hague in March 2002. Abstracts are available on the ICES web site, plus a report on the outcome of the conference. The aim of compiling an annual phytoplankton report similar to that of WGZE was noted by SGQAE with appreciation. A report with plankton research and monitoring would then be available.

SGQAE reviewed relevant biological studies and related QA activities in member countries. WGPE took note of the development of a national standard for phytoplankton in Norway. This, however, might be superseded by the emerging CEN standard. Norway is reviewing its existing monitoring programmes to assess their suitability for meeting the monitoring requirements of the WFD. The Netherlands has achieved a continued national accreditation for phytoplankton and chlorophyll-a analysis as part of the national monitoring programme (MWTL). The development of a national standard for phytoplankton analysis (in English) was finalised in 2002. The emerging CEN standard for phytoplankton is based on this document. The Netherlands has planned a pilot in 2003 on the use of PAM-fluorescence for measuring primary production. Swedish EPA is heavily involved in evaluating existing standards for use in WFD. In addition they are evaluating existing programmes for their suitability to meeting the requirements of the WFD.

SGQAE reported on accomplished and planned intercalibrations of phytoplankton and chlorophyll. Intercalibrations have been realised in Germany and Latvia. The HELCOM Phytoplankton Expert Group is planning a phytoplankton intercomparison in late spring 2003.

WGPE took note of the presentation of ICES data reporting formats. ICES are moving from V3.1 to V3.2 (November 2002) because of some problems with the first release of V3. Format reports data on Phytoplankton, Zooplankton, Phytobenthos & Zoobenthos. It will be used for the next 10 years but phytobenthos has not been tested. ICES will continue to support 3.1. Data submissions must still be in ASCII format – ICES are considering XML and other database formats. ICES will not accept spreadsheets since there are significant problems with cell formatting that affects the number of decimal places. ICES cannot control the format and do not have the resources to investigate each individual spreadsheet. Kari Nygaard, Norway, expressed concern over the ICES database-reporting format – many countries are uneasy over the rigidity of the ASCII format. Since ICES are planning on a 'modern' format (XML) in a few years, many countries are waiting for the newer format rather than spending resources on developing routines to write ASCII output. If ICES do not solve these problems, there is a significant risk that other organisations will develop their own systems rather than use the established ICES system.

ICES is planning to use the ITIS codes (Integrated Taxonomic Information System – http://www.itis.usda.gov/). There was discussion on the route for obtaining new ITIS codes for species in the ICES/HELCOM area which are not yet registered. It was agreed that such codes could be sought under ICES auspices in order to facilitate the process. However, this would not obviate the need for expert input from individuals/institutes in relation to nomenclatural matters, and any other queries that may arise. The potential use of ITIS as a common taxonomic system within ICES is a special ToR of WGPE (see ToR h).

The review of the reports of SGQAB and SGQAE resulted in the following discussion within the WGPE. Concerning the standard method of chlorophyll measurements, WGPE is missing a review, discussion and evaluation of the Chlorophyll standard method, which was prepared by Aminot and Ray some years ago. It is now published in ICES Time Series 38.2002. It was stressed by several members of WGPE that, although there are a number of initiatives for developing standards for chlorophyll, we have to aim for a common standard. The steps towards this go through a European standard within the WDF. WGPE has to work for an agreement on this in order to reach comparability. There is no doubt that HPLC determination of chlorophyll is the best method. But it is also clear that this method is too complicated to use as a standard monitoring tool. The ideal solution would be to have one laboratory to analyse all chlorophyll, but this is obviously unrealistic. Instead the idea of creating a reference lab seems to be adequate.

Concerning phytoplankton it was found that a standardisation is much needed. The Netherlands has developed a standard by now and this will be used as a model for the German standard. CEN also developed a draft of a standard method for phytoplankton analysis. As for chlorophyll there seems to be several parallel initiatives. It would seem appropriate to gather these initiatives to one within the WFD. WGPE stressed the importance of intercomparisons and ring tests for phytoplankton. In some countries, e.g., France, Germany and the Netherlands participation is mandatory.

4.2 ToR b – Elaborate the outcome of the work of the Study Group on an ICES/IOC Checklist of Phytoplankton and other Protists

Unfortunately there is no news about the ICES/IOC Checklist of Phytoplankton and other Protists. WGPE found this unsatisfying and discussed ways to solve this problem. A way to get things going is to compile a WGPE checklist, based on the input of available personal, institutional and national checklists. We are aware of a number of such lists. It was decided that all members (and others, if possible) should send their lists to Peter Bot, who will be responsible for the compilation. The list should include *species name, author, synonyms* and *origin*. When the compilation is completed taxonomic experts should check the list.

Recommendation

Phytoplankton checklist to be compiled by 1 October 2003 from the ICES/IOC, ICES WGHAB and other checklists available on European and North American waters, including those identified in previous reports from ICES WGPE. Deliverable is checklist with suitable nomenclature for database inclusion. The combined merged checklist for phytoplankton will be handed over to the ICES Marine DataBase Manager for the control of the format.

4.3 ToR c – Outline the consequenses of the potential termination of a unique North Sea phytoplankton 30 year time series from the Marsdiep station in the southern North Sea

The termination of phytoplankton time series continues to be a problem and of great concern for WGPE. Already in last year's report it was said that ICES was not in a position to make any statement on continuation of phytoplankton time series. It was also recommended by WGPE the continuance of the time series. At this time, the 30 years Marsdiep time series is probably run for the last year. This unique long-term programme of phytoplankton and nutrients is a key reference site for continental coastal waters in the North Sea. However, the cost of running the programme has become so large that it is not possible any longer. Other mandatory tasks have to be prioritised. It seems at present, as the only long-term programme for phytoplankton in the North Sea area is the one at Helgoland. Also here there is a plan to reduce the sampling frequency. Automated systems are taking over the monitoring of the sea. In terms of phytoplankton this is unfortunate, as there is no method of analysing phytoplankton species composition and species abundance this way. At best, the bulk biomass of autotroph phytoplankton can be determined by fluorescens. This, however, will not give any indication of the total phytoplankton biomass and much less any information of the presence of toxic and in other ways harmful phytoplankton species. Using only automated monitoring will result in a loss of biodiversity information. A lot of the future monitoring will obviously rely on modelling, which however is dependant of real data for validation.

4.4 ToR d – Organise a Workshop in collaboration with Working Group on Zooplankton Ecology, on modelling phytoplankton-zooplankton interactions

The background for organising a Phytoplankton – Zooplankton Workshop is the detailed discussion between WGPE and WGZE in Bergen, Norway, 2001. During that discussion the issue of phytoplankton abundance and size distribution control by grazers was raised and concern that the phytoplankton research community has not benefited very much from modelling efforts was stressed. The fact that studies to develop detailed information about phytoplankton and zooplankton species are often done independently and as a result insight into the complex interactions between the two groups is usually lacking. It was also said that the interaction between phytoplankton and zooplankton depends on the size of the organisms. During the discussion it was commented that zooplankton and phytoplankton workers view the grazing problem quite differently and the common ground needs to be developed more. It was suggested that a workshop approach might be best in which there were a review of the status and a development of a plan on how to proceed. Such a workshop could be tied to a joint meeting of our two working groups and would be an extension of this group meeting.

At the present meeting the idea of organising the Workshop on modelling phytoplankton-zooplankton interactions was revisited and developed. As a start it was suggested that the Workshop should be held in conjunction with the 2004 annual meetings of WGPE. Enrique Nogueira, Gijon, Spain, offered to host the meeting. Several practical things were suggested and discussed, but at this time no firm decisions were taken. There is a need to work with the planning intersessionally.

Preliminary ideas for the workshop include:

Time:	2 days during 15–25 February 2004, in conjunction with annual meeting of WGPE
Location:	Gijon, Spain
Invited speakers:	Several names were discussed
Funding:	Uncertain. If we invite speakers, we need funding
Format:	Lectures and posters

4.5 ToR e – Prepare contributions on phytoplankton monitoring for the inclusion in the Summary Report on plankton monitoring results in the ICES area

Already in 2001 WGPE and WGZE identified areas of collaboration. One such area is the annual status reports on standard sections and time series stations of phyto- and zooplankton in the ICES area. At the present meeting some examples of phytoplankton reports were presented. The aim is that all participating countries should compile these reports annually and that they should be merged with the corresponding zooplankton summary status report.

In **Annex 3** the reports from Germany, The Netherlands and Sweden are presented.

4.6 ToR f – Review reports from OSPAR concerning the eutrophication status of the OSPAR area

This ToR could not be properly addressed, due to the lack of background documents. This lack was made clear before the WG meeting, but no documents were provided.

The objective of the eutrophication status report of the OSPAR area was to produce a harmonised assessment. In order to accomplish this, Ecological Quality for phytoplankton communities, benthic communities, oxygen consumption and nutrient budgets have been identified.

Elements of Ecological Quality have been chosen to be monitored in order to signal the progress of nutrient reduction. These are, phytoplankton communities, benthic communities, oxygen consumption and nutrient budgets. Elements of phytoplankton communities are chlorophyll a, which is considered as a good measure of the amount of phytoplankton in the water. WGPE finds it attractive because it is very easy to measure. At the same time it is not without problems, as the chlorophyll concentration does not tell the whole story. A large part of the phytoplankton biomass may consist of heterotrophs, which are not caught by the chlorophyll measurement. The considerable temporal and spatial variation in chlorophyll concentrations makes it necessary to have different levels for different areas and seasons. WGPE also see a problem to find the proper background levels of chlorophyll. The other element of phytoplankton communities is phytoplankton indicator species. It seems as all countries are not using phytoplankton species as quality element, which underline the lack of harmonisation. The use of phytoplankton as indicators of the trophic state of a sea area may give more information than chlorophyll. The choice of indicative species, however, is far more problematic in marine waters than in fresh water. Increased nutrient concentrations will result in an increased growth of phytoplankton and in some cases of certain species. There may also be a structural change in the phytoplankton community, which may serve as a warning signal. The suggested choice of eutrophication indicators Phaeocystis and Noctiluca seems suitable, although the direct relation with eutrophication is not always clear. It is also clear that these species are not always natural elements of the plankton flora in all parts of the OSPAR area. The suggested harmful phytoplankton species may serve as indicators for the quality of the water, but not always as a measure of eutrophication. The trend that modellers are now working on species level opens up the possibility of using species specific models for the assessment of eutrophication in the OSPAR area.

4.7 ToR g – Consider the HELCOM experience with respect to primary production measurements in environmental monitoring programmes

The measurement of primary production in the HELCOM Combine programme is not mandatory, but is listed as supporting studies. It seems that only three or four HELCOM countries measure primary production today. This is also reflected in the assessment proceedings. In the last assessment volume, published 2002, primary production results were almost absent. Thus, in short, it seems that Primary Production measurements are on their way to disappear. This is unfortunate, as it is the only regular rate measurement in the Baltic Monitoring Programme. The primary production has important links to eutrophication and sedimentation and, consequently, to deep water oxygen concentrations. In order to get an overview of the situation and thoughts about primary production measurements it was decided by SGQAB to circulate a questionnaire to HELCOM member countries. The questionnaire had been delayed for several reasons. The questionnaire was revised in the light of the outcome of the Primary Production Conference in Bangor, UK, 2002, and then reviewed by the joint SGQAE/SGQAB group. A few changes were suggested and the document amended accordingly. It will be circulated directly to laboratories/individuals who have participated in recent meetings, requesting that their responses are returned by 1 November, 2003.

The questionnaire is included as **Annex 4**.

4.8 ToR h – Consider the potential of ITIS as a common taxonomic system within ICES

The WGPE discussed the decision by ICES to use the Integrated Taxonomic Information System (ITIS), (http://www.itis.usda.gov/) as the standard system for use in data exchange and internal database work, as well as ITIS itself.

WGPE had received the information of the ICES decision of the use of ITIS in September 2002, and noted with surprise that "After consultations with relevant ICES working and study groups during the autumn of 2001 and spring 2002, ITIS, including TSN Codes, …. .has been agreed to be the better option available and will be introduced as the ICES standard….". WGPE consider itself as a relevant working group for this question, but has not been asked to give its comments.

The WGPE is well aware of the need of a taxonomic coding system and the need of firm rules for the database system. There are, however, a number of open questions, which need to be clarified, and also a number of things that need to be developed before this system is ready for operational work. According to the web-site, ITIS is mainly an American undertaking, based on agreement between USA, Canada and Mexico. Concerning phytoplankton this is clearly seen in the content in the way that considerable amounts of species present in European waters are not included.

A simple check of a number of marine phytoplankton species gave a disappointing result, revealing that the list contains numerous mistakes in spelling and taxonomy, as well as the lack of species. There seems to be no, or little inclusion of species from a number of checklists, e.g., HELCOM list, IOC list of Potential Harmful Microalgae. Moreover the ITIS list does not seem to be maintained. We found phytoplankton species names in the list that had undergone taxonomic revision and got new names – generic as well as species - before 1995, i.e. more than 8 years ago. The list, if to be used, must be continuously updated, which is a considerable task. This has to be clarified between ICES and ITIS.

The way the ITIS list is presented on the web makes it extremely complicated to use. A system of browsing is an absolute minimum of user friendliness. The WGPE also found the coding of species strange and of very little help in sorting species into groups, like diatoms, dinoflagellats etc.

The WGPE concludes that there is a strong need for ICES to work on the ITIS list before it can be accepted and used as a helpful tool. Until this is done it will take too much work for individual data providers to manage and adapt their phytoplankton data. Moreover, it will result in considerable double work, which may anyway have to be redone at ICES.

5 ANY OTHER BUSINESS

a) Scientific presentations and discussions

During the meeting a number of presentations of phytoplankton issues were given by WGPE members and local scientists.

Claus Dürselen: BEQUALM ring test results. **Annex 5**

Francisco Rey: Sverdrup´s critical depth theory, 50 years after: is it still of actuality?

Enrique Nogueira: Temporal changes of microplankton community structure driven by hydrographic, weather-induced variability and the representation of phytoplankton community structure on simulation models. **Annex 5**

Hervé Claustre & Julia Uitz: Inferring phytoplankton community composition from surface Chl a: analysis of a HPLC pigment data base **Annex 5**

Juan Carlos Molinero: The North Atlantic Oscillation and the low frequency variability of planktonic copepods in the NW Mediterranean: the *Centropages typicus* case study **Annex 5**

Philippe Grosjean: Nouvelles techniques d'identification (semi-) automatique du plancton par l'analyses d'image **Annex 5**

b) The status of the WS on Contrasting Approaches to Understanding Eutrophication Effects on Phytoplankton

Peter Bot informed that a number of manuscripts had been delivered, but that many had been delayed. This had resulted in a change of deadline until 31 May. The publication of the papers will be in the Journal of Sea Research.

c) Appropriate links of national and international institutions performing monitoring or other phytoplankton activities

Francisco Rey drew attention to a very useful web site, which contains numerous links to institutions working with phytoplankton: http://www.dvz.be/Portal/main.htm

d) Election of a Co-Chair

The Chair, Lars Edler, informed the meeting that there is a serious problem of funding the participation in ICES Working Groups that are not directly involved in fishery business in Sweden now. It seems likely that Swedish representation in the WGPE will not be possible in future. Therefore, Lars Edler suggested that a Co-Chair should be appointed. The WGPE asked Francisco Rey to act as Co-Chair. Francisco accepted this task.

e) Concluding business

The WGPE thanked Hervé Claustre and Laboratoire d'Oceanographie de Villefranche for hosting the 2003 meeting. Dr Enrique Nogueira, Centro Oceanografico de Gijon. Instituto Espanol de Oceanografia, kindly offered to host the WGPE meeting 2004.

6 RECOMMENDATIONS

Phytoplankton checklist to be compiled by 1 October 2003 from the ICES/IOC, ICES WGHAB and other checklists available on European and North American waters, including those identified in previous reports from ICES WGPE. Deliverable is checklist with suitable nomenclature for database inclusion. The combined merged checklist for phytoplankton will be handed over to the ICES Marine DataBase Manager for the control of the format.

The WGPE recommends the Questionnaire on Primary Production to be circulated by national delegates and returned by 1 November, 2003. The questionnaire is included as **Annex 4**.

The WGPE recommends the support for the Workshop of modelling of Phytoplankton-Zooplankton interactions, in Gijon, Spain in February 2004.

7 DRAFT RESOLUTIONS

Proposed terms of references for the WGPE 2004 Meeting:

The ICES Working Group of Phytoplankton Ecology (WGPE) (Chair L. Edler, Sweden) will meet in Gijon, Spain, around 20th of February to:

a) Review the reports of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic (SGQAB) and the Steering Group on Quality Assurance of Biological Measurements in the Northeast Atlantic (SGQAE);
b) Elaborate the outcome of the work of the Study Group on an ICES/IOC Checklist of Phytoplankton and other Protists;
c) Review the Phytoplankton Checklist compiled by WGPE during 2003;
d) Review annual Phytoplankton Summary Reports and discuss standardization of data sets;
e) Review the results of the use of ITIS in the phytoplankton data reporting to ICES;
f) Carry out the Workshop on modelling of Phytoplankton-Zooplankton interactions;
g) Review the outcome of the primary production questionnaire;
h) Report and discuss new findings;

The WGPE will report within six weeks to the Oceanographic Committee

Supporting information

Priority:	The activities of this group are fundamental to the work of the Oceanography Committee. They are critical in understanding links between physics and Living Marine Resources and play an important role in identifying environmental change. The work of this group is regarded as high priority.
Scientific Justification:	a) This is a repeating task of WGPE as the work of SQGAB and SGQAE is of relevance to WGPE. Feedback to and from these Steering Groups plays an important role in ensuring relevant expertise is available to the groups and that WGPE is kept informed of developments. b) The work of SGPPT in developing a Checklist of Phytoplankton and other Protists is of direct interest to the work of WGPE and benefits from its attention and feedback. c) Due to the problem of accomplishment of the work in SGPPT the WGPE feels a responsibility to help carry the phytoplankton checklist project through. The phytoplankton society as well as ICES database are in acute need of a comprehensive checklist of phytoplankton. Critical assessments of the phytoplankton situations can only be performed if the taxonomic status of species is well updated. d) The WGPE recognises the need for disseminating information of the phytoplankton status in a timely manner. The material presented will be used to prepare the annual Summary Status Report on Phytoplankton in the ICES area. Reporting results must be supported by significant observations and trends based on time series sampling programmes. e) The introduction of ITIS for the ICES database is not well met by the data providers, due to its complicated organisation and difficulty to use. Therefore there is a strong need to evaluate the use of the system, to identify its weakness and consider the users opinion and to suggest improvements. f) The difficulties in modelling the ecosystem functioning imposed by the limits to understand phytoplankton-zooplankton interactions is recognised in recent literature. There is a need to communicate with modellers to review the advances in integrating ecosystem models. A modelling workshop under the auspices of the WGPE and the WGZE was proposed during the 2001 discussions. The WGPE wants to accomplish this in connection with the annual 2004 meeting. g) The outcome of the Primary Production Questionnaire will be of great help for OSPAR in its need to learn about Primary Production experience with regard to usefulness, interest and spatial and temporal resolution of state and rate variables as well as biogeographic provinces. Primary Production measurements are important as they are coupled with key site process measurements through collaborative efforts with research community. h) The WGPE is a perfect forum for presenting the state of the art and new findings of phytoplankton ecology. It stimulates discussions on topics of general interest, which motivates this term of reference.
Relation to Strategic Plan:	These working groups activities embrace all elements of the scientific objective of understanding the physical, chemical, and biological functioning of marine ecosystems.
Resource Requirements:	None required
Participants:	WGPE continues to see the need to encourage wider participation and especially to draw in relevant experts in areas of specific interest as required.
Secretariat Facilities:	None required
Financial:	None, apart from report's reproduction cost
Linkages to Advisory	The Group reports to ACME, mainly for the provision of scientific information on phytoplankton

Committees:	and their role in ecosystem function.
Linkages to Other Committees or Groups	Members of the WGPE are active participants in range of other committees and groups including SGQAB, SGQAE and SGPPT
Linkages to Other Organisations	Members of this group are active in IOC HAB Programme, HELCOM, EuroGOOS and OSPAR

ANNEX 1: LIST OF PARTICIPANTS

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ANNEX 2: AGENDA OF THE MEETING

Tuesday 11th March

9.30 – 10.00	Welcome and practical matters
10.00 – 10.45	Outcome of Actions from 2002
10.45 – 11.15	COFFEE
11.15 – 11.45	Review the reports of the ICES/HELCOM SGQAB and ICES/OSPAR SGQAE (**ToR a**)
11.45 – 12.00	Report of the work of the Study Group on an ICES/IOC Checklist of Phytoplankton and other Protists (**ToR b**)
12.00 – 12.30	Consider the potential of ITIS as a common taxonomic system within ICES (**ToR h**)
12.30 – 13.30	LUNCH
13.30 – 14.00	Update on Web links to relevant data products
14.00 – 14.30	The status of the WS on Contrasting Approaches to Understanding Eutrophication Effects on Phytoplankton
14.30 – 14.45	COFFEE
14.45 – 15.30	Outline the consequences of the potential termination of a unique North Sea phytoplankton 30 year time series from the Marsdiep station in the southern North Sea and other long time series (**ToR c**)
15.30 – 17.00	Working Group business

Wednesday 12th March

9.00 – 9.25	Hervé CLAUSTRE/Julia UITZ: Inferring phytoplankton community composition from surface Chl a: analysis of a HPLC pigment data base
9.25 – 9.50	Juan Carlos MOLINERO: The North Atlantic Oscillation and the low frequency variability of planktonic copepods in the NW Mediterranean: the *Centropages typicus* case study
9.50 – 10.15	Philippe GROSJEAN: Nouvelles techniques d'identification (semi-) automatique du plancton par l'analyses d'image
10.15 – 10.45	Laboratoire d'Oceanographie de Villefranche
10.45 – 11.00	COFFEE
11.00 – 11.45	Temporal changes of microplankton community structure driven by hydrographic, weather-induced variability and the representation of phytoplankton community structure on simulation models. (Enrique Nogueira)
11.45 – 12.30	Sverdrup's critical depth theory, 50 years after: is it still of actuality? (Francisco Rey)
12.30 – 13.30	LUNCH
13.30 – 14.15	BEQUALM ring test results. (Claus Dürselen)
14.15 – 15.00	Contributions on phytoplankton monitoring for the inclusion in the Summary Report on plankton monitoring results in the ICES area (**ToR e**)
15.00 – 15.15	COFFEE
15.15 – 17.00	Report preparation

Thursday 13th March

9.00 – 10.30	Review reports from OSPAR concerning the eutrophication status of the OSPAR area (**ToR f**)
10.30 – 10.45	COFFEE
10.45 – 12.30	*Continue* Review reports from OSPAR concerning the eutrophication status of the OSPAR area (**ToR f**)
12.30 – 13.30	LUNCH
13.30 – 14.00	Consider the HELCOM experience with respect to primary production measurements in environmental monitoring programmes (**ToR g**)
14.00 – 15.00	Organise a Workshop in collaboration with Working Group on Zooplankton Ecology, on modelling phytoplankton-zooplankton interactions. (**ToR d**)
15.00– 15.15	COFFEE
15.15 – 16.00	Any other business
16.00	Closing of the meeting

ANNEX 3: PHYTOPLANKTON STATUS REPORT

Germany

MURSYS

Marine Environment Reporting System

Information from the North Sea and Baltic Sea

prepared by BSH Hamburg

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

Phytoplankton - Summary (2001) for the North Sea

January/February:

Phytoplankton in the North Sylt Wadden Sea was composed of the typical winter species; 73 different **diatom** species and 20 **dinoflagellate** species were observed. The genera *Thalassiosira* and *Odontella* were relatively frequent, as were *Chaetoceros* species.

March/April:

On the whole, the **species composition** of phytoplankton showed the normal seasonal pattern. Near Norderney, the **foam-forming alga** *Phaeocystis globosa* reached its maximum abundance in mid-April. At the same time, a bloom of the **diatom** *Odontella sinensis* was observed. Late April/early May also marked the beginning of the growth period of the **bioluminescent alga** *Noctiluca sinensis*.

In the North Sylt Wadden Sea, the spring bloom developed relatively early and was dominated by the **diatom** *Odontella aurita* (biomass: 60–90 µg chlorophyll/litre). Also the development of the **foam-forming alga** *Phaeocystis globosa* began in late March. At the end of April, this alga was quite frequent and dominant among plankton.

May:

In the North Sylt Wadden Sea, the spring bloom of **diatoms** was followed by a minor *Phaeocystis* bloom which reached its maximum in mid-May. During the whole period, the species spectrum was dominated by **diatoms** and **dinoflagellates**. While the number of **diatom** species decreased slowly, an increase in **dinoflagellate** species was observed. The dominant species was the **foam-forming alga** *Phaeocystis globosa* (early May) and the **diatom** *Cerataulina pelagica* (early June).

Off Helgoland, *Cerataulina pelagica*, *Leptocylindrus minimus* and *Pseudo-nitzschia seriata* were the prevailing **diatoms**. Among **flagellates**, an increase in *Raphidophyceae* was observed.

June:

An unusually early second bloom of the **foam-forming alga** *Phaeocystis globosa* with exceptionally high cell concentrations (over 7000 cells/litre) occurred near Norderney in mid-June, causing strong foam formation on the beaches. Major developments of larger **diatom** species were not observed.

West of Sylt, the chain-forming **diatom** *Cerataulina pelagica* was most abundant. In the Schleswig-Holstein coastal waters, *Dinophysis norvegica*, *Protoperidinium punctulatum*, and *Torodinium robustum* were ubiquitous. Also **tube-shaped and Odontella diatoms** were present.

Near Helgoland, accumulations of the autotrophic **ciliate** *Myrionecta rubra* and many small colonies of the **foam-forming alga** *Phaeocystis globosa* were observed toward the end of the month. The abundance of plankton increased.

July:

The typical seasonal **Noctiluca** development in the high seas off Helgoland occurred very late this year. Extensive areas of the sea showed an impressive dark red discoloration caused by the autotrophic **ciliate** Myrionecta rubra.

Near the North Frisian islands, **colonies of foam-forming algae** (*Phaeocystis globosa*) became more abundant. Northwest of Sylt, **colonies of foam-forming algae** as well as **diatoms** (*Cerataulina pelagica, Skeletonema costatum*) were observed.

The calm and very warm summer weather at the end of July led to the expected formation of orange-coloured algal mats, so-called "red tides", caused by mass developments of the **luminescent dinoflagellate** *Noctiluca scintillans* in the German Bight.

Phytoplankton in the North Sylt Wadden Sea showed a relatively normal development. Only few of the typical seasonal **dinoflagellate** species were observed (*Diplopelta bomba, Noctiluca scintillans*). **Diatom** species prevailed (*Actinoptychus senarius, Bellerochea malleus, Cylindrotheka closterium, Guinardia delicatula, Lithodesmium undulatum, Odontella rhombus*). The group of **Chaetoceraceae** was present with the largest number of species, which is typical of the season. Only single occurrences of potentially toxic species were reported.

August:

In the Wadden Sea of Lower Saxony, potentially toxic or bloom forming algae occurred only in non-critical concentrations.

Near Helgoland, the abundance of **diatoms** was low. Concentrations of small **flagellates** increased slightly; of the larger **dinoflagellates**, *Ceratium fusus* and few *Dinophysis norvegica* and *Prorocentrum micans* were found. At the end of the month, an increase in the abundance of **flagellates** was observed, with many small species like *Prorocentrum minimum*.

Phaeocystis was quite frequent in the North Sylt Wadden Sea in early August - which has become a typical summer phenomenon. As in July, no unusual blooms occurred in this area in August. Observations of toxic algae were rare.

An unusually low abundance of plankton was observed in the coastal waters of Schleswig-Holstein. **Diatoms** (*Rhizosolenia imbricata*) were more abundant than **dinoflagellates**. The potentially toxic **flagellate** *Fibrocapsa japonica* was found at all stations, but in uncritical concentrations.

September:

In the Wadden Sea of Lower Saxony, an increasing abundance of **diatoms** of the *Pseudonitzschia* group was observed between Accumer Ee and the river Jade. In its eastern part, slightly higher cell concentrations of the potentially toxic **armoured dinoflagellate** *Dinophysis acuminata* were observed in the second half of the month.

Off Helgoland, the diversity of **diatom** species (*Chaetoceros socialis, Lithodesmium undulatum, Melosira sulcata, Odontella sinensis*) was still large but concentrations were low. There were many different species of small naked **flagellates**. The abundance of *Dinophysis acuminata* increased toward the end of the month.

In the coastal waters of Schleswig-Holstein, plankton growth had clearly decreased. Although more diatom species were observed than **dinoflagellates** (*Gymnodinium sp., Prorocentrum triestinum*), cell concentrations remained low in almost all areas.

October/November:

In the Wadden Sea of Lower Saxony, critical cell concentrations of **potentially toxic species** (*Dinophysis acuminata, Chrysochromulina*) were not observed.

Colonies of the **foam-forming alga** *Phaeocystis* occurred only sporadically in October. The abundance of the **bioluminescent alga** *Noctiluca miliaris* was generally low at all stations along the East Frisian coast.

Diatoms of the *Pseudo-nitzschia* group and the ciliate *Myrionecta rubrum* were not found at any of the stations at the end of October.

Near Helgoland, phytoplankton stocks were low. Observations of the potentially toxic *Dinophysis acuminata* were still frequent in early October. The **diatom** species *Melosira sulcata* and *Odontella sinensis* were observed as well as single *Rhizosolenia robusta* cells. Among **flagellates**, primarily small cells were found; **Ceratia** were hardly observed any more. **Nauplius** continued to be relatively abundant until late October.

In the North Sylt Wadden Sea, phytoplankton showed the normal seasonal development; no exceptional blooms were observed. The species spectrum of **diatoms** was much larger than in summer, which is typical of the season. It was large in comparison with the preceding years. **Chaetoceraceae** showed the highest species diversity, which is normal for the season. The most abundant **dinoflagellates** were *Noctiluca scintillans* and *Prorocentrum micans* (potentially toxic).

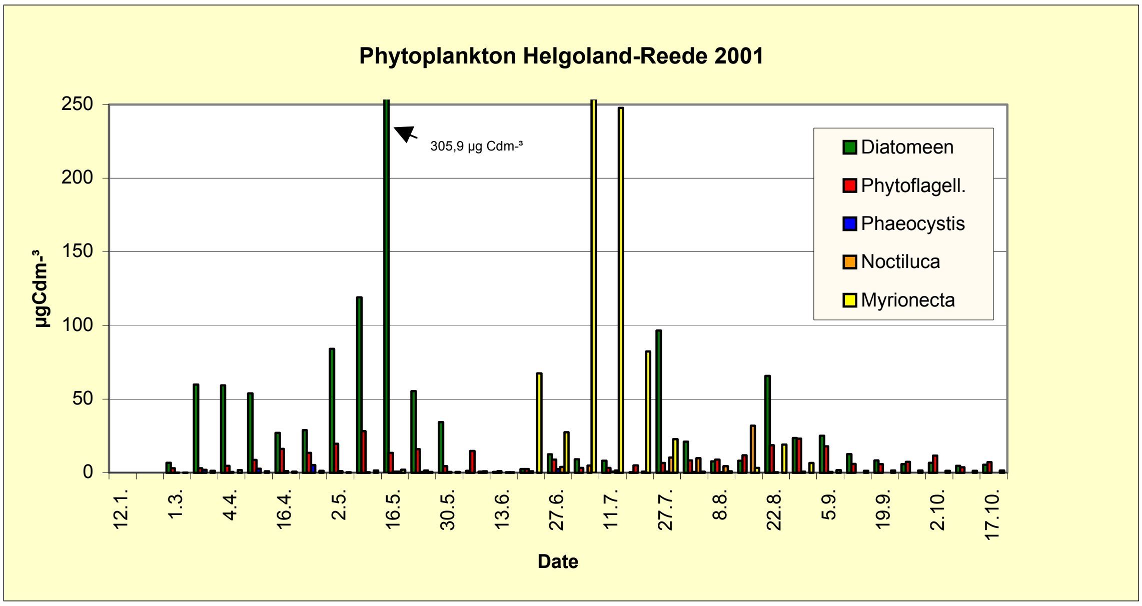


Figure 1: Phytoplankton at the monitoring station Helgoland-Reede 2001.

References:

MURSYS: Meeresumwelt-Reportsystem Informationen aus Nord-und Ostsee Bundesamt für Seeschifffahrt und Hydrographie Bernhard-Nocht-Str.78, 20359 Hamburg (http://bsh.de/Meeresumweltschutz/Mursys/1517.htm)

BAH: Biologischen Anstalt Helgoland in der Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (a) 27498 Helgoland / (b) Hafenstraße 43, 25992 List/Sylt (http://www.awi-bremerhaven.de/BAH/index.html)

LUNG: Landesamt für Natur und Umwelt des Landes Schleswig-Holstein Hamburger Chaussee 25, 24220 Flintbek (http://www.schleswig-holstein.de/landsh)

NLÖ: Niedersächsisches Landesamt für Ökologie, An der Mühle 5, 26548, Norderney (http://www.nloe.de)

The Netherlands

Phytoplankton monitoring in the Dutch marine waters (2001)

In the framework of a biological monitoring programme of the National Institute for Coastal and Marine Management / RIKZ, phytoplankton has been sampled on a regular base in the Dutch coastal waters since 1990. The programme covers 31 permanent sample stations situated in the North Sea (17 stations), the Dutch Wadden Sea and Ems-Dollard estuary (5), and four areas in the Rhine-Scheldt-Meuse estuary, *viz.* Oosterschelde (4), Westerschelde (3), and two (embanked) salt-water lakes: Lake Grevelingen and Lake Veere (one station in each lake).

In general, stations were sampled 1–4 times each month. Samples were normally taken from the surface. However, if the water column was stratified on a station during summer, samples were also collected from the thermocline and from approximately 3 m above the seabed. In the microscopical analysis, the species composition and the concentration of each individual species were assessed in a standardised procedure.

In order to summarize the results, phytoplankton was categorized into three species groups (dinoflagellates, diatoms and other species), and for each station the seasonal development of these groups are available. In 2001, both the seasonal and the spatial development of phytoplankton were more or less similar as in previous years. During the winter period, densities were generally low. This period was followed by a blooming period of especially diatoms on most stations in spring. On stations located onshore, diatom densities were much higher then on stations offshore. During summer, blooms of various species and species groups were observed. Flagellates were more dominant offshore in comparison with onshore stations. After September the densities decreased considerable at all stations. In the two salt-water lakes, Lake Grevelingen and Lake Veere, picoplankton was numerically an important group.

The total number of species observed in 2001 was 354, which is comparable to the numbers found in previous year. However, some species were observed for the first time in the Dutch marine waters: *Peridinium quinquecorne*, *Chaetoceros pseudocurvisetus, Membraneis challengeri*, *Rhizosolenia phuketensis, Algirosphaera, Pyrocystis hamulus*, *Pseudo-nitzschia seriata* f *obtusa* and *Thalassiothrix longissima*. These species have well defined characteristics and it is therefore unlikely that they were present before 2001. The first six species are well known in warmer areas and were observed during summer. The last two species originate from the North Atlantic and were observed during the winter

The development of *Phaeocystis* since the start of the monitor programme in 1990 was analysed in relation to eutrophication. According to literature, both the length of the annual blooming periods and the ratio between two life forms, *flagellates* and *colony cells*, would be suitable indicators for the eutrophic status of seawater. On two onshore stations 2 and 10 km off the Dutch coast, the blooming period seemed to have increased from approximately two to three months. Other locations however did not show a clear trend. The very low contribution of colony cells on offshore stations supports the supposed positive relationship between the eutrophic status and the contribution of colony cells.

At several stations, concentrations of potentially toxic species from the genera *Alexandrium*, *Dinophysis* and *Pseudo-nitzschia* exceeded a formulated reference level. In 2001, observed maximum concentrations of *Dinophysis*, *Pseudo-nitzschia* en *Phaeocystis* were higher than in 2000, especially at stations located onshore in the southern North Sea and at stations 4 and 10 km north off the Wadden Sea.

Since several of the *Pseudo-nitzschia* species are toxic, the occurrence of species from this genus was analysed from the 2000 and 2001 data. From 2000 onwards, assessment of *Pseudo-nitzschia* species have been brought to a lower taxonomic level. A few species that were previously not distinguished and classified into species groups are now being counted separately. If species groups comprise of both toxic and non-toxic algae, division of species groups is of importance for water quality and management. In 2000 and 2001, the toxic species *P. seriata* f *seriata* has been recorded offshore only, especially on offshore stations North of the Wadden Sea. The toxic species *P. pseudo-delicatissima*, was only found offshore on the TERSCHELLING-transect. Another toxic species, *P. multiseries* cannot be distinguished from the non-toxic species *P. pungens* yet by conventional light microscopy. In order to detect toxic species in the framework of regular monitoring programmes, knowledge of the temporal and spatial distribution of individual species can be an important tool to optimise these programmes.

In order to assess Coccolithophorids, samples were collected only on one station 135 km north of the Wadden Sea and processed separately. In 2001, Coccolithophorids were found from May up to and including December. *Emiliania huxleyi* was the most common species. In samples from August, *Algirosphaera* sp. was found. This is probably the first recording of this species for the North Sea.

Sweden

Phytoplankton - Summary 2002 for the Skagerrak, Kattegat and the Baltic sea
SMHI

SKAGERRAK

January/February:

Phytoplankton in the Skagerrak was composed of the typical winter species. Cryptophyceans, e.g. *Teleaulax* spp., the Prasinophyean *Pyramimonas* spp., and were abundant. The diatom *Skeletonema costatum* was present as single cells or chains.

March/April:

Spring bloom situation with large amounts of diatom species, a few dinoflagellates and lots of *Phaeocystis. Chaetoceros socialis* and *Thalassiosira nordenskioeldii* were the dominant diatoms with 750 000 and 570 000 cells per litre respectively. Other abundant diatoms were *Skeletonema costatum, Chaetoceros debilis, Rhizosolenia hebetata* and *Chaetoceros curvisetus*. The flagellate *Phaeocystis* sp. was common, whereas the dinoflagellates *Ceratium longipes*, *Dinophysis norvegica*, *Heterocapsa rotundata* and *Lingulodinium polyedrum* were present in small numbers.

June:

Dominance of small *Chaetoceros* spp. with 600 000 cells/l, followed by *Skeletonema costatum* with 500 00 cells/l. *Dactyliosolen fragilissimus* and *Pseudo-nitzschia delicatissima* also very common. Single cells of *Dinophysis acuminata* and *D. acuta*. *Chrysochromulina* spp. present with about 65 000 cells/l

July:

Small *flagellates and coccoids* dominating with about 1 million cells/l. *Ceratium furca* common with about 9 000 cells/l. *Dinophysis acuminata*, *D. acuta* and *D. norvegica* present with 3 000 cells/l all together. The diatom *Dactyliosolen fragilissimus* common with 17 000 cells/l.

August:

Relatively small amounts of phytoplankton present. Small monads and flagellates dominating with more than 1 million cells per liter. About five diatom species with *Cerataulina pelagica*, *Leptocylindrus danicus* and *Proboscia alata* most common. Among the dinoflagellates *Heterocapsa minima* and *Ceratium furca* dominated. *Dinophysis acuta* and *D. norvegica* present with less than 100 cells per liter each.

September:

Near the coast a rich plankton flora was present with *Ceratium furca*, followed by *Prorocentrum micans*. Other *Ceratium* species were also relatively common, as well as *Dinophysis acuminata* and *Lingulodinium polyedrum*. The diatoms were dominated by *Cerataulina pelagica* but other species e.g., *Proboscia alata, Ditylum brightwellii, Pseudo-nitzschia* spp. and *Chaetoceros* spp. were also seen.

December:

Ceratians dominated with about 11 000 cells per liter of *C. lineatum* and 2 000 cells per liter of *C. fusus*. Among diatoms, *Thalassiosira punctigera* was present with about 2 000 cells per liter. *Dinophysis acuminata, D. acuta* and *D. norvegica* were present with less than 100–200 cells per liter each. The large diatom *Coscinodiscus wailesii* was common in the net sample.

KATTEGAT

January/February:

Single cells of *Ceratium furca* and *C. lineatum* and of the potentially toxic *Dinophysis acuminata* and *D. norvegica* were present. Although in very low cell density, several species of the diatom genus *Chaetoceros* were found. Other diatoms present in low density were *Detonula confervacea*, *Rhizosolenia hebetata* and *Skeletonema costatum*. The Cryptophycean *Teleaulax* spp. and small monads and flagellates were common.

March/April:

The spring bloom was at a late stage. The diatoms *Thalassiosira nordenskioeldii, Skeletonema costatum* and *Chaetoceros socialis* dominated with 280 000, 120 000 and 20 000 cells per litre respectively. The flagellate *Apedinella radians* was very common with 170 000 cells per litre and *Phaeocystis* sp. was relatively common. Among dinoflagellates *Heterocapsa rotundata* was the most abundant with about 100 000 cells per litre. Single cells of *Dinophysis acuminata* were observed.

May:

Poor flora with dominance of *Skeletonema costatum*. Single cells of *Ceratians*. *Chrysochromulina* spp. present with about 50 000 cells per litre. A possible *Alexandrium minutum* was also observed in small numbers (< 1 000 cells per litre). *Ciliates* relatively common.

June:

Restricted flora with dominance of *Dactyliosolen fragilissimus* (~150 000 cells/l). *Thalassionema nitzschioides* and *Skeletonema costatum* common. *Chrysochromulina* spp. present with about 50 000 cells/l.

July:

Relatively poor plankton flora with the exception of small *flagellates and coccoids* which made up about 1 million cells/l. The Cryptophycean *Plagioselmis prolonga* present with about 30 000 cells/l. *Ceratium furca* common with about 16 000 cells/l. *Dinophysis acuminata* and *D. acuta* present with about 200 cells/l each and *D. norvegica* with 900 cells/l. The diatom *Leptocylindrus danicus* common with 14 000 cells/l.

August:

Considerable bloom of *Ceratium furca* with 100 000 cells per liter. Of the other few dinoflagellates present *Prorocentrum micans* and *P. minimum* were the most abundant. Diatoms were rare. Only *Cerataulina pelagica* and *Proboscia alata* were present. The Cryptophyceans *Plagioselmis prolonga* and *Teleaulax* sp. were relatively common.

September:

A rich plankton flora dominated by dinoflagellates was present. *Lingulodinium polyedrum* dominated, followed by *Ceratium furca*. Other *Ceratium* species and *Dinophysis acuta* were also relatively common. The small amounts of diatoms observed were *Chaetoceros affinis, C. curvisetus*, *Leptocylindrus danicus* and *Proboscia alata*. A few threads of *Nodularia spumigena* were also seen.

December:

Diatoms in small densities dominated the poor plankton flora. *Thalassiosira punctigera* was present with about 1 000 cells per liter. Dinoflagellates were rare. A few cells of *Dinophysis acuta* were present.

Southern Baltic Sea

February:

Very poor planktonflora. Single cells of the diatoms *Skeletonema costatum*, *Actinocyclus octonarius*, *Chaetoceros danicus*, *C. impressus* and *Coscinodiscus* sp. and the dinoflagellate *Peridiniella catenata*. Filaments of the cyanobacterium *Aphanizomenon* sp. (baltica) present in the net sample.

March/April:

The spring bloom was about to start, which was seen by the development of *Skeletonema costatum* present with about 700 000 cells per litre and small numbers of *Chaetoceros wighamii*. The common spring dinoflagellate *Peridiniella catenata* was present. Single filaments or cells of *Aphanizomenon* sp. ("*baltica*"), *Nodularia spumigena, Thalassiosira baltica, Melosira arctica* and *Chaetoceros impressus* were found.

May:

Small species dominated this post spring situation. Among the most common were *Pyramimonas* sp., *Plagioselmis prolonga, Chrysochromulina* sp.* and *Dinobryon balticum. Aphanizomenon* sp. was present in the net hauls only. Very small amounts of *Skeletonema costatum* and *Thalassiosira baltica* were found. *Ciliates* were very abundant.

June:

Small species dominated. The most common was *Chrysochromulina* sp.*, amounting to about 400 000 cells/l. Other flagellates of importance were *Pyramimonas* sp. and Cryptophyceans. Diatoms were missing and dinoflagellates were present only in small amounts. *Planktonema lauterbornii* was present with about 10 000 cells/l. Among bluegreens, *Aphanizomenon* sp. was present with about 0.8 m/l, whereas *Anabaena* sp.* and *Nodularia spumigena** occurred with single filaments only. Cf. *Aphanocapsa* sp. was also observed.

July:

At this time the blue-greens have started to be very abundant. There is a complete dominance of *Aphanizomenon* sp. with 15–20 m/l. *Nodularia spumigena** was present, but in much lower concentrations; about 3 m/l. In the eastern part the amounts of bluegreens were much smaller. The diatom *Dactyliosolen fragilissimus*, which is relatively rare in this area because of the low salinity in the Arkona basin, was present with about 15 000 cells/l and *Chaetoceros impressus* with about 1 000 cells/l. The green algae *Planctonema lauterbornii* was common.

August:

Blue-green algae were common in the water. *Aphanizomenon* sp. dominated with about 14 meter per liter, whereas *Nodularia spumigena** had only 0.1–0.5 meter per liter. The potentially toxic dinoflagellate *Prorocentrum minimum* bloomed with 1.63 million cells per liter in the western part. The diatom *Chaetoceros impressus* was common and small amounts of the diatoms *Dactyliosolen fragilissimus* and *Proboscia alata* indicated inflow of saltier water.

September:

Phytoplankton were rare at this time. The tinntinnid *Helicostomella* completely dominated. A few cells of *Chaetoceros impressus, C. affinis* and *Coscinodiscus* sp. were the only diatoms present. Among dinoflagellates *Dinophysis acuminata*, D. norvegica*, Prorocentrum micans* and *Ceratium furca* and *C. tripos* were seen in small numbers. A few threads of *Aphanizomenon* sp. and *Nodularia spumigena** were also seen.

December:

A very poor plankton flora. Small flagellates dominated. Most common was *Teleaulax* sp. with about 34 000 cells per liter. Among larger forms, the diatom *Chaetoceros impressus* was found. In the net sample *Coscinodiscus granii* and *Actinocyclus octonarius*. and *Dinophysis acuminata*, D. norvegica** and *Aphanizomenon* sp. were seen.

Central Baltic Sea

February:

Very poor planktonflora. Single cells of the diatoms *Skeletonema costatum*, *Actinocyclus octonarius*, *Chaetoceros danicus*, *C. impressus* and *Coscinodiscus* sp. and the dinoflagellate *Peridiniella catenata*. Filaments of the cyanobacterium *Aphanizomenon* sp. (baltica) present in the net sample.

March:

East of Gotland the winter situation was ending and the first few cells of the spring bloom were developing. *Skeletonema costatum*, *Aphanizomenon* sp. ("*baltica*"), *Nodularia spumigena, Snowella* sp., *Thalassiosira baltica, Actinocyclus octonarius* and *Peridiniella catenata* were found. West of Gotland winter conditions were still prevailing. Very little phytoplankton were observed. Only in the net sample some species turned up, e.g., *Aphanizomenon* sp. ("*baltica*"), *Nodularia spumigena, Snowella* sp*., Skeletonema costatum, Chaetoceros danicus, Actinocyclus octonarius* and *Peridiniella catenata*.

May:

East of Gotland small flagellates with *Pyramimonas* sp., *Plagioselmis prolonga*, *Pseudopedinella tricostata*, *Chrysochromulina* sp. and *Dinobryon balticum* were common. Small amounts of *Thalassiosira baltica*, *Chaetoceros wighamii* and single cells of *Peridiniella catenata* were seen. *Aphanizomenon* sp. was present in the net hauls only. West of Gotland a poor plankton flora was dominated by small flagellates; *Pyramimonas* sp., *Plagioselmis prolonga*, *Pseudopedinella tricostata*, *Chrysochromulina* sp. and *Dinobryon balticum*. Small amounts of *Thalassiosira baltica* and *Actinocyclus octonarius* as well as *Dinophysis acuminata*. *Aphanizomenon* sp. was present in net hauls only.

July:

East and west of Gotland *Aphanizomenon* sp. was present in large amounts with about 14 m/l. *Nodularia spumigena** was present with about 3 m/l. There was also cf. *Aphanocapsa* sp. in relatively large amounts. *Chrysochromulina* spp.* and *Pyramimonas* spp. together with *Plagioselmis prolonga* and *Teleaulax* spp. were also found.

August:

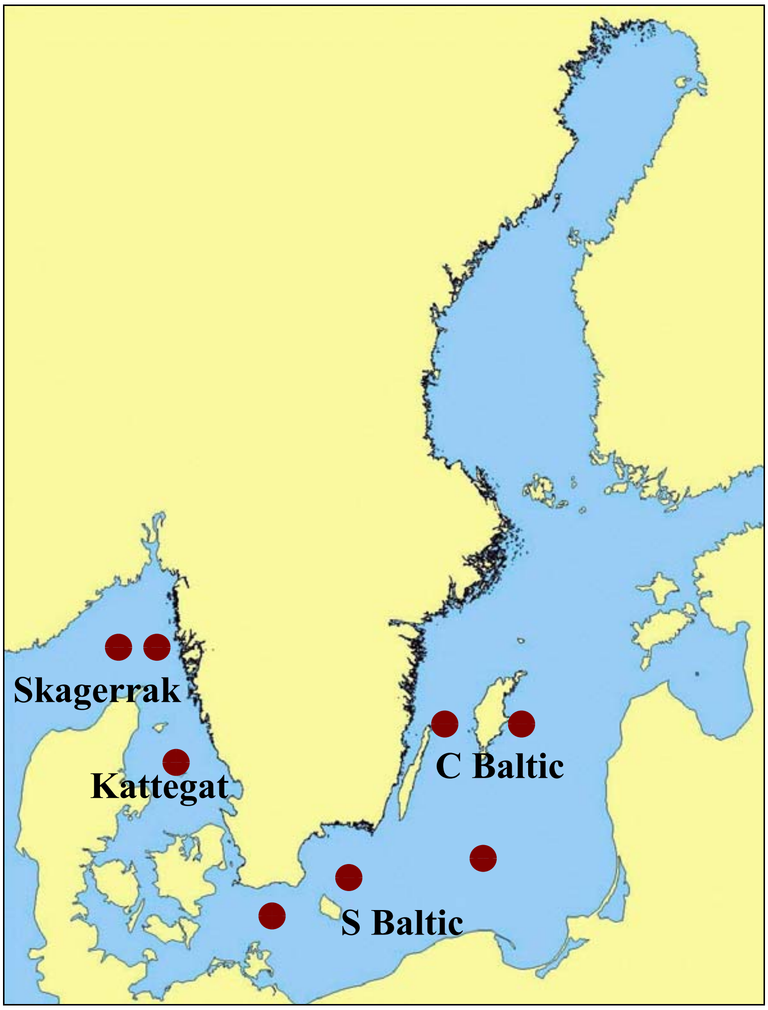
East of Gotland there was a considerable accumulation of blue-green algae floating in the surface water. Outside of the thickest accumulations about 9 meter per litre of *Aphanizomenon* sp. and 7 meter per litre of *Nodularia spumigena* were found in the 0–10 meter water layer. The Tinntinnid *Helicostomella* sp. was very common. West of Gotland *Aphanizomenon* sp. dominated with about 1 meter per litre, whereas *Nodularia spumigena* was present in very small amounts. The Tinntinnid *Helicostomella* sp. was very common.

September:

East of Gotland there was a considerable amount of zooplankton, with a dominance of *Helicostomella.* Small amounts of *Nodularia spumigena* were present and the diatom *Actinocyclus octonarius* was very common. West of Gotland the tinntinnid *Helicostomella* dominated. Large amounts of blue-greens were present. *Nodularia spumigena**was most common, followed by *Aphanizomenon* sp. and then *Anabaena* sp.

December:

East of Gotland small amounts of the large diatoms *Chaetoceros impressus, C. danicus, Coscinodiscus granii* and *Actinocyclus octonarius*. In the net sample *Dinophysis acum*inata*, *D. nor*vegica* and *Aphanizomenon* sp. were seen. West of Gotland hardly any phytoplankton observed Only a few cells of *Pyramimonas* sp. and *Choanoflagellates* were seen. In the net sample, however, both *Aphanizomenon* sp. and *Nodularia spumigena**, as well as *Ebria tripartita* and *Gyrodinium spirale* were found. The diatoms *Thalassiosira baltica* and *Chaetoceros wighamii*, both typical for the spring bloom, were also seen.


Skagerrak
Kattegat
C Baltic
S Baltic

ANNEX 4: QUESTIONNAIRE ON THE PRESENT EXTENT OF PRIMARY PRODUCTION MEASUREMENTS IN THE ICES AREA

March 2003

QA/AQC ACTIVITIES RELATED TO STUDIES OF BIOLOGICAL COMMUNITIES IN THE ICES AREA

Dear Colleague

Following the recommendation of the ICES/HELCOM Steering Group on Quality Assurance of Biological Measurements in the Baltic (SGQAB) and the Steering Group on Quality Assurance of Biological Measurements in the Northeast Atlantic (SGQAE), I am writing to request your response to a short questionnaire concerned with the nature of current commitments to QA/AQC activity in relation to Primary Production Measurements in the ICES area. The purpose is to obtain an up-to-date summary of the overall extent of present efforts, in order to be able to target our work to meet the QA/AQC needs of individual laboratories and member countries.

Please find the time to contribute to this important survey and return it at latest by Monday 8 September

Please send an E-mail if you want the questionnaire as a file.

Lars Edler
SMHI
Doktorsgatan 9 D
SE-262 52 Ängelholm
Sweden
tel: +46 431 80854, fax: +46 431 83167, E-mail: lars.edler@smhi.se

I look forward to hearing from you.

Yours sincerely

Lars Edler
Chair of ICES Working Group on Phytoplankton Ecology

Questionnaire on the present extent of primary production measurements in the ICES area

1. Which type of institution are you in?

   ☐ University laboratory
   ☐ Governmental laboratory
   ☐ Non-profit research organization
   ☐ Large commercial organization
   ☐ Commercial consultancy

2. What country are you located in (the address of your institution is optional: see question 10, below)?

3. Are you or your organization taking part in any type of quality assurance/analytical quality control activity related to these targets?

   ☐ No
   ☐ Yes If Yes, at which level:
   ☐ in-house only
   ☐ between laboratories
   ☐ between countries

4. What is the name of any organised scheme that you participate in, and for how long have you participated?

5. Do you have written in-house procedures for the conduct of community studies (covering field sampling, laboratory analysis and/or data management), for example, in the form of Standard Operating Procedures?

   ☐ Yes
   ☐ No If No, please specify what other procedures you follow (*e.g.,* published national/international guidelines)?

6. Is your laboratory/organisation accredited?

   ☐ No
   ☐ Yes If Yes, what form does the accreditation take and what is the name of the of the accreditation organization?

   accrediting organization?

   ☐ Are you seeking accreditation?

7. Are you measuring Primary Production for…………….

☐ Regional (sub-national) monitoring
☐ National monitoring
☐ International monitoring
☐ Research (specify)
☐ No ………….. THANK YOU FOR YOUR PARTICIPATION

8. How do you improve and secure your personal professional skills?

☐ Sampling and sample-handling Workshops (if yes, how often?)
☐ Taxonomic training Workshops (if yes, how often?)
☐ Intercalibrations (if yes, how often?)
☐ Take part in ring-tests (if yes, how often?)
☐ Other (please specify)

9. May we refer to your institution by name in connection with any examples of 'best practice'? (*NB. We will NOT refer to named institutions/individuals under any other circumstances, and the confidential nature of your response is therefore assured*)

☐ Yes
☐ No

10. Which method do you use for Primary Production measurements at your lab in general?

☐ *IN SITU*
☐ Incubator
☐ Simulated *in situ*

11. Is your lab measuring Primary Production according to the HELCOM COMBINE Manual?

☐ YES
☐ No

12. If using incubator, what kind are you using?

☐ ICES INCUBATOR
☐ Home built incubator
☐ Other incubator

13. I case you measure *in situ*, please outline details such as depth, incubation time, incubation duration etc.

……
……
……
……

14. I case you use *incubator*, please outline details such as depth, incubation time, incubation duration etc.

……
……

……
……

15. What kind of bottles do you use and how are they “shadowed” to different light intensities?

……
……
……
……

16. In case you are not using the ICES incubator, what are the intercomparison results?

……
……
……
……

Please return completed questionnaires - preferably by e-mail to: lars.edler@smhi.se

or by post to:

Lars Edler
SMHI
Doktorsgatan 9 D
SE-262 52 Ängelholm
Sweden

Summary of the BEQUALM phytoplankton ring tests

Claus-Dieter Dürselen, AquaEcology

Ring test 1 phytoplankton

Introduction

The purpose of this inter-laboratory phytoplankton ring test was to evaluate the state of the art of phytoplankton analysis and to compare the performance of laboratories engaged in national official or non-official phytoplankton monitoring programmes all over Europe. As such it is the first inter-laboratory exercise bringing together laboratories from the different marine provinces of Europe: the North Sea, the North Atlantic, the Baltic Sea and the Mediterranean Sea.

The first ring test included three tasks, representing the three variables of phytoplankton analysis: (a) species identification, (b) estimation of biovolumes, and (c) cell counts (concentrations). The problem of species identification in a field sample was not addressed in this exercise; nevertheless, the participating laboratories were asked to identify the 4 cultured phytoplankton species provided in the mixtures. Biovolumes are not routinely estimated by all monitoring labs. Emphasis in this ring test was put on the cell counts.

Participants

32 laboratories from 13 European countries participated in the ring test. As some labs returned multiple result sheets (more that 1 investigator per lab), the total number of returned result sheets was 40. The majority of participating labs are from the North Sea and Atlantic coasts, whereas the Baltic and Mediterranean Seas are somewhat under-represented. Although the Baltic Sea is among the most monitored areas in the world, the interest in the present ring test was relatively low. A reason for this might be the high number of local ring tests that have been performed in the Baltic Sea over the past decades, so that the labs did not see the necessity to participate in this one. For the Mediterranean, the number of monitoring laboratories is relatively low (as compared to the North and Baltic Seas).

Fig.1. Geographical distribution of the participating labs in Europe.

Test material

The test material consisted of 3 water samples. Each sample represented a mixture of 4 cultured phytoplankton species, which were mixed together at different proportions. Species were chosen to represent the most prominent taxonomical classes in coastal waters, 2 diatom and 2 flagellate species. In order to approach natural conditions, the 4 species were mixed to simulate 3 different ecological conditions as they can be observed in nature: (a) intermediate, "balanced" conditions, with no group dominating, (b) a diatom bloom and (c) a flagellate bloom.

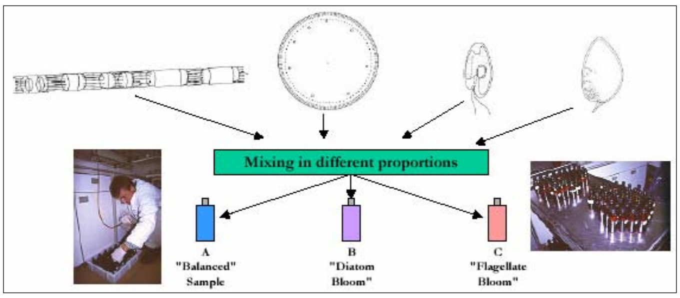


Fig.2. Preparation of phytoplankton mixtures and samples for the ring test.

Species identification

Although species identification was not the prime objective in this exercise, investigators were asked to identify the species, 2 of which were common species and easy to identify (*Skeletonema costatum* and *Prorocentrum micans*). The other 2 species (*Thalassiosira puntigera* and *Rhodomonas sp. c.f. salina*) were isolated from the Wadden Sea and are less easy to identify.

P. micans was identified correctly by all investigators. For *S. costatum*, 92% of the labs identified the species correctly, 5% identified it to the genus, and 3% did not identify it at all. It is obvious that the common genera *Skeletonema* and *Prorocentrum* were identified almost 100% correctly, whereas *T. punctigera* was identified correctly by only 25% of the labs (Genus *Thalassiosira*: 41%). *Rhodomonas sp. c.f. salina* was correctly identified to the genus by 36% of the labs, but 64% correctly identified it as a cryptophyte.

These data show that species identification is an expert task. An experienced investigator is crucial for an extensive analysis of field samples.

Cell Counting

The robust means of the prepared samples were taken as standard values for the calculation of z-scores, which are a measure of lab performance. Z-scores represent the standardized deviations from the robust mean, i.e., the difference between the lab value and the mean value, divided by the robust standard deviation.

The smaller the z-score, the closer the counting result is to the robust mean, i.e., the better the result. Negative values imply a negative difference from the reference value (underestimation), positive ones mean a positive one (overestimation).

A laboratory resp. investigator is considered successful if at least 80% of the z-scores are within the acceptance limit ($z < 2$). According to this procedure, 72.5% of all participants were considered successful.

The results of this ring test demonstrate the high level of expertise in the phytoplankton monitoring labs all over Europe. Also, there were no apparent differences between the respective research areas or countries. However, a detailed analysis of the data showed that the labs with the highest z-scores (= least successful) were labs with no or little experience in counting phytoplankton samples. It was also evident that the highest z-scores were associated with the use of Sedgwick-Rafter counting chambers and a concentration method other than sedimentation. It should be stated as a main conclusion of the present ring test that Sedgwick-Rafter chambers are not suitable for counting phytoplankton in field samples. In most cases, natural concentrations are too low for this equipment.

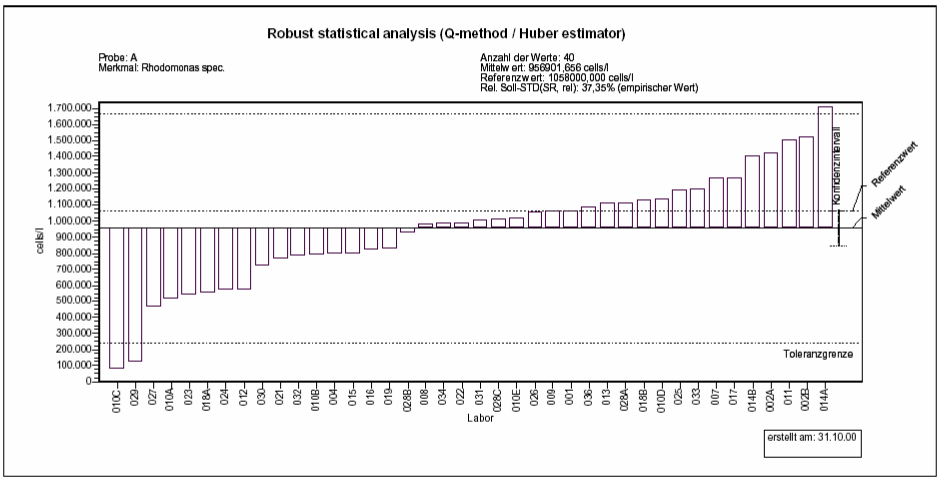


Fig.3. Reported cell concentrations with robust mean (solid line), reference count (centre dotted line), tolerance levels (upper and lower dotted line), and confidence interval of the mean. Sample A: *Rhodomonas sp.*

Biovolume

Laboratories were asked to size the phytoplankton cells and calculate the respective biovolumes, if this was part of their routine work. 11 result sheets containing biovolume data were returned.

For the diatoms, the stereometric shapes are well defined, and all labs chose the cylinder as appropriate form (Table 4). For the dinoflagellate *Prorocentrum micans*, however, only one lab chose the form recommended by Edler (1979), and for *Rhodomonas sp*., none of the labs applied the shape recommended by Edler (1979) or Hillebrand *et al.* (1999). The differences in biovolumes between the labs are due to 2 factors: (1) different measurements of the linear dimensions (length, width) and the third dimension (height), which must be estimated from the known 3-dimensional shapes, and (2) the different 3-dimensional shapes and respective stereometric formulas applied.

In general, it can be stated that the appropriate choice of a stereometric formula and precise measurements of cell dimensions are equally important to a good approximation of cell biovolume. Especially the “estimation” of the third (hidden) dimension in most cell types, which cannot be directly measured in fixed samples, must be carefully carried out. For this purpose, the observation of live samples can give some clues.

Ring test 2 phytoplankton

Introduction

This second BEQUALM phytoplankton ring test is the successor of the 1st BEQUALM Phytoplankton ring test which was completed in 2000. While in the previous ring test, the method of analysis was freely decided by the respective participating labs, RT2001 was designed to test the extent to which a unified methodology can improve the quality of monitoring data. In RT2001, the participants were asked to determine the cell concentrations and individual biovolumes of 3 phytoplankton species in two different mixtures, simulating a diatom and a flagellate bloom, respectively.

Participants

27 laboratories from 12 European countries participated in RT2001. As some labs returned multiple result sheets (more that 1 investigator per lab), the total number of returned result sheets was 42.

Test material

The test material consisted of 2 water samples. Each sample represented a mixture of 3 cultured phytoplankton species, which were mixed together at different proportions. Species were chosen to represent the most prominent taxonomical classes in coastal waters, a diatom and 2 flagellate species. In order to approach natural conditions, the 3 species were mixed to simulate two different ecological conditions as can be observed in nature: (a) a diatom bloom and (b) a flagellate bloom.

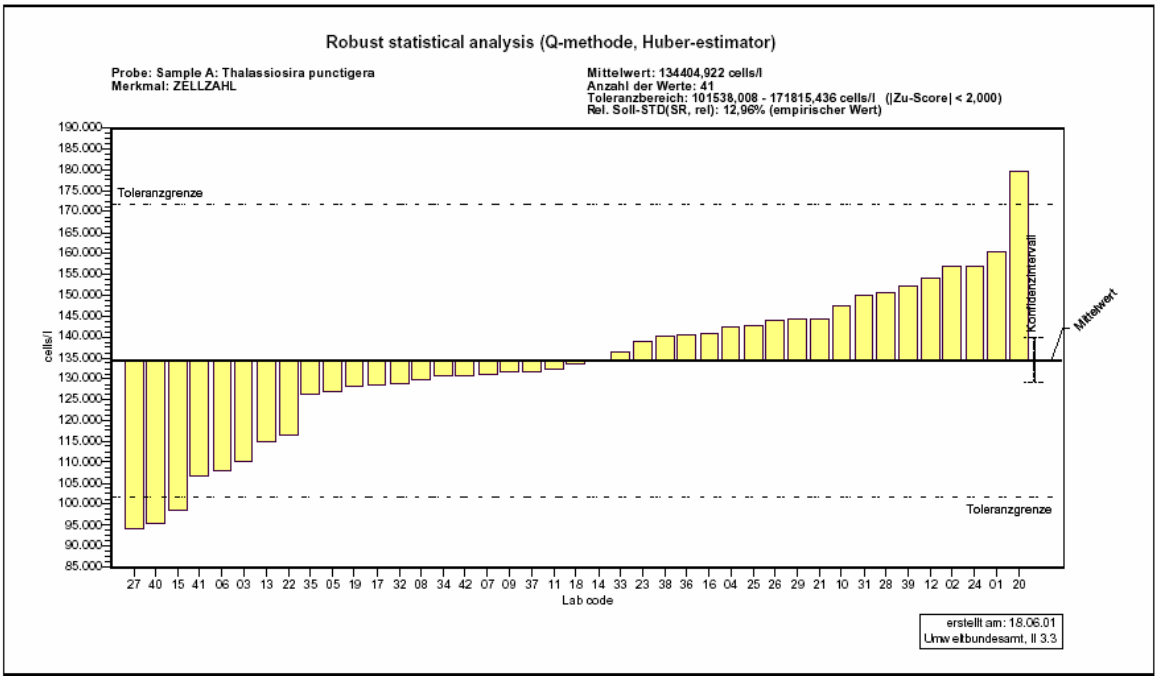
Cell counts

Of the 42 data sets, 8 data sets were considered “not successful” according to the above given criterion (at least 80% of analyses within the tolerance limit of $Z < 2$, i.e., at least 5 out of 6 analyses). This means that for the counting task, 81% of the participants were successful. This represents an improvement over the result from 2000 (72.5% successful). The overall Z-Scores could be considerably improved as well (mean absolute Z-Score 2001: 1.013; mean absolute Z-Score in 2000: 1.554). The variability between the labs was reduced considerably (CV = 103.5% for 2001 vs. 187.7% for 2000). This means that the accuracy (i.e., degree to which the data match true or accepted values), as well the precision (i.e., degree of variability) of the data could be improved to some extent. This demonstrates that the implementation of a standardized methodology for phytoplankton counts is required to improve the quality and comparability of data on the European scale.

Biovolume

Different errors made by the calculation by several labs demonstrate that careful scrutiny of the data is necessary before they are submitted to an official authority or data inventory.

The imponderability of different cell shapes and formulas used by the different labs for the same species were eliminated in RT2001. For the previous ring test, no Z-scores were calculated due to the small number of participating laboratories in the biovolume task, so a direct comparison based on Z-Scores is not possible. However, the coefficients of variation of reported biovolumes show an improvement of precision (lower CV) only for *P. micans* and *R. salina*, but not for *T. punctigera*. This is presumably due to the fact that the cell shape and biovolume formula for *Thalassiosira* (cylinder) was identical among the data sets in RT2000, as well as in both ring tests, whereas for the flagellates, a range of different shapes and formulas were applied. Thus, the standardization in RT2001 resulted in a reduced interlaboratory variation, albeit this reduction seems rather small.



Conclusion phytoplankton ring tests

The results of both ring tests show that a comprehensive standard protocol is necessary for all steps in quantifying phytoplankton: from sampling via counting to data calculation. But this is only a first step to minimize differences between labs. The different identification of only a few species also indicates the strong necessity for carrying out international taxonomical courses for different phytoplankton groups.

Phytoplankton ring tests should be performed every three or four years as a regular evaluation for the labs. This should not only be done with samples from lab cultures but also with samples from the natural environment. Such ring tests could be performed by several organisations.

The role of hydrodynamic, weather induced variability on microplankton species composition and community structure changes

Enrique Nogueira

Dr Enrique Nogueira presented the results of a high resolution sampling (every 2–4 days) conducted during two complete years with contrasting meteorological regimes (years 1987 and 1991) in the Ria de Vigo, an estuarine ecosystem affected by coastal upwelling (Nogueira *et al.*, 2000; Nogueira and Figueiras, in press). The main results confirm: (1) the major relevance of meteorological variability, acting at interannual, seasonal and short-term scales (i.e., meteorological disturbances), in shaping the structure and temporal changes of the microplankton community, and (2) the applicability of the concept of adaptive strategies for an ecological interpretation of species assemblages and to understand the response of the community to external (i.e., allogenic), meteorologically-driven control.

Nogueira E., Ibanez F., Figueiras F.G. (2000) Effect of meteorological and hydrographic disturbances on the microplankton community structure in the Ria de Vigo (NW Spain). Mar. Ecol. Progr. Ser., 203: 23–45.

Nogueira E, Figueiras, F.G. (in press) The succession in the Ría de Vigo revisited: Role of hydrographic, weather induced variability on microplankton assemblages and changes of community structure. J. Mar. Sys.

Simulation of microplankton community structure: Application of an individual-based simulation model

Enrique Nogueira

Dr Enrique Nogueira presented the results derived from the application of the Lagrangian-Ensemble method (i.e., an individual-based model type) to simulate changes in microplankton community structure. The model structure represents a food-chain plankton ecosystem (NPZD; nitrogen-phytoplankton-zooplankton-detritus), where the members of a size-structured phytoplankton community compete for light (i.e., PAR, photosynthetically active radiation) and DIN (dissolved inorganic nitrogen, = $NO_3^- + NH_4^+$). No niche diversification in the form of resource partitioning or selective grazing is considered. The metabolic rate parameters of the process functions for phytoplankton are specified according to allometry (i.e.). The allometric approach confers competitive advantage to the smaller phytoplankton in a wide range of environmental conditions, while larger cells out compete the smaller cells under extreme light environments (i.e., photo-inhibition and extreme low PAR). The model reproduces reasonably well the climatological values for the studied area (off Azores). Despite the competitive advantage of the smaller cells, no competitive exclusion takes place; stable Co-existence is achieved during the three simulated years due to the internalisation of variability at the individual level as a consequence of the individual-based approach.

Nogueira E., Woods J.D., Harris C., Field A.J., Talbot S. (in preparation). Co-existence in the plankton ecosystem.

Inferring phytoplankton functional groups from surface Chl *a*: analysis of a HPLC pigment data base

Hervé Claustre & Julia Uitz

HPLC analysis

One analysis ✍✍ ~30 pigments (Chlorophylls and carotenoids)

☯ biomass (Chl*a*)

☯ community structure (from small to large phytoplankton). “Chemotaxinomic biomarkers”

☯ Photophysiological properties

TIME TO MERGE DATABASES AND START SYNTHESIS

Remote sensing of ocean colour

Surface Chl*a* is a variable which is in common within satellite dataset and HPLC dataset

<u>OBJECTIVE</u>: *combine results to derive global fields of phytoplankton community composition (and photo-physiology)*

Conclusion:

✍ existence of relationship between phytoplankton biomass in the surface layer, community structure and photo-physiology

✍ community composition (phytoplankton functional groups) and photophysiology can be indexed on Chl*a* content.

✍ possibility of inferring synoptical fields of community composition from remote sensing

✍ <u>These fields would be essential (?) for global biogeochemical models (initialisation / validation)</u>

The North Atlantic Oscillation and the low frequency variability of planktonic copepods in the NW Mediterranean: the *Centropages typicus* case study

Juan Carlos Molinero

* Biological data: 26 year series (1967–1992) at weekly frequency
* Hydrological data: temperature and salinity at standard depths, weekly frequency
* Meteorology data: recorded at Cap Ferrat with a daily frequency
* Winter North Atlantic Oscillation

- www.cru.uea.ac.uk/cru/data/nao.htm

* Atmospheric mass balance over the North Atlantic between Azore Islands and Iceland
* Stronger influence during winter

Changes on hydrology and planktonic population in high latitudes are extensively documented, no reports on the reponse of mediterranean planktonic populations to this influence

Hypothesis:

Winter environmental conditions constitute the main physical forcing for the development and annual production of *C. typicus*

Conclusion:

(i) **basin hydrological changes**

(ii) changes in the **composition of microplankton** communities which alter the diet composition of copepods

(iii) individual biological responses: **fecundity**, probable changes on **developmental time** and on the time of first reproduction and **species interaction**

Nouvelles techniques d'identification (semi-)automatique du plancton par l'analyses d'image

Philippe Grosjean

Why use image analysis?

Image analysis is the only method that can potentially provide both size and identification of all particles in a sample

Require very high resolution and fast digitizing systems:*Zooscan: 18,000 x 7,500 pixels, > 150 Mb each.*

Require powerful computers with lot of memory and storage capacity: *Zooscan: 1,5 Gb RAM, 100+ Gb disk minimum.*

Require powerful identification algorithms: It is one of the most difficult cases in « machine learning » applications.

Resolution of recent imaging systems and power of latest and fastest computers are compatible with the application of zooplankton image analysis

A new machine learning algorithm (dvf) allows higher recognition levels (> 75% in our test series, and 85–90% using a complementary semi-automatic method)

Large-scale practical applications are now possible, such as analysis of historical or long-term series, and online experts consulting

Visit the Zooscan web site at http://www.sciviews.org/zooscan