Oceanography Committee **ICES CM 2001/C:07**
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Report of the

Working Group on Zooplankton Ecology and joint meeting with Working Group on Phytoplankton Ecology

Bergen, Norway
26–29 March 2001

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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0 EXECUTIVE SUMMARY

The meeting was held at the Institute of Marine Research (IMR) at Bergen, from 26–29 of March and was attended by 8 members of the Working Group on Zooplankton Ecology representing 5 ICES countries.

The discussion of the Terms of Reference was preceded by an introduction on the Oceanography Committee discussions during the 88th Statutory Meeting. This included an outline of the current structure of the OC and the possibility that the Working Group on Zooplankton Ecology might be incorporated into a new functional group. The evolution of the group was outlined by looking at the list of *Tors* discussed since its foundation nine years ago and at the list of deliverables that were produced in this period. It was also noted that the actions proposed by the group at its 2000 meeting [(i) Publication of a web page on the Zooplankton Methodological Manual and (ii) Edition of the Zooplankton Status Report] were achieved on schedule.

The discussion on *Tor a* "Inputs to the Summary Status Report on the zooplankton monitoring structure in the ICES area" gained the unanimous support of all the members in considering the Summary Status Report as an annual contribution of this group to the OC and resulted in the identification of the ways in which the report for the year 2000–2001 could be improved without involving major new work.

The use of biological indices and data produced on a routine basis for the fisheries and environmental assessment groups (*Tor b*) is something demanded from different panels (US GLOBEC, SPACC, ICES) and the group decided to be proactive in this discussion. A list of indices of potential value for understanding zooplankton dynamics and ecosystem functioning was produced (the list is open to new items). This *Tor* was considered to have high relevance for the group and further discussions are needed before clear conclusions can be achieved.

A compilation of the results, publications and other material from the June 1993 Seagoing Workshop in Storfjorden (*Tor c*) was presented. The information is now archived in four CD-ROM: Methods and Results (1 CD), Acoustic data (2 CDs) and Video images on the use of plankton gears at sea (1 CD). The members of the group acknowledged the effort required for the compilation of these results and it was proposed that the four CD-ROM set should be offered to ICES for wider distribution.

The results of the Workshop on taxonomy of Calanoids (Germany, 14–17 May, 2000) conducted under the auspices of this Working Group were presented and the conclusions reviewed (*Tor d*). The group supported the conclusions and decided: (i) to support a new workshop on taxonomy in 2003, SAHFOS offered its premises to hold the workshop and the group accepted its invitation (SAHFOS is widely recognised for its excellence in plankton taxonomy and possesses the facilities necessary for holding such a workshop); and (ii) compile in a "demonstration CD-ROM" a scanned version of all the plankton leaflets published by ICES since 1939 which will be linked by a numerical and taxonomic index (i.e., Plankton leaflet No. 187). A first version of the "Demo CD-ROM" (with a dozen leaflets) will be presented during the 2001 ASC. The ultimate objective is that ICES could offer such products to a larger community of scientists.

The current advances in the organization of the ICES/PICES/GLOBEC Symposium were reviewed (*Tor e*) and Dr P. Wiebe and Dr L. Valdés were nominated as representatives of ICES on the Steering Committee of this Symposium; the group also consider that Dr M. Tackx should be included as a member of the Organising Committee (the group will approach her). The symposium title is maintained as approved by the ICES and PICES Councils "The Role of Zooplankton in Global Ecosystem Dynamics: Comparative studies from the World Oceans". The Belgium offer of hosting the Symposium at Bruges in the spring of 2003 was considered as the best option.

The group also discussed and prepared a list of key questions requiring interdisciplinary dialogue (*Tor f*) for possible Theme Sessions at the ASC of 2002 and 2003. Five titles were selected after a discussion on main interest and priorities of this group. Two of them will be addressed as Theme Session for the 2002 ASC and the others will be postponed for future ASC. The choices for 2002 were: (i) Environmental conditions in extraordinary fish stocks year classes (e.g., haddock) and (ii) Flows into shelf seas from ocean boundary currents: hydrobiological implications and effects on fish stocks.

The Working Group on Zooplankton Ecology and the Working Group on Phytoplankton Ecology next met in a joint meeting to discuss issues of mutual interest. Both groups recognised the ambitious agenda and the difficulties to reach clear conclusions. The discussion on the "Limits for modelling phytoplankton-zooplankton interactions" (*Tor g1*) and "How do characteristics of phytoplankton diet influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?" (*Tor g2*) were shown to have many points in common and we recognised that the bottlenecks must be solved in conjunction with specialist in modelling. A proposal for organizing a Workshop in modelling in 2003 was launched, and a Term of reference addressed to prepare such workshop will be included in both Working Groups for the 2002 agenda.

The *Tor g3* "Can a collapse in grazing pressure lead to symptoms of eutrophication?", was discussed from a theoretical approach and illustrated with a few field examples (Narragansett Bay and North Sea). The conclusion was that there is evidence that grazing pressure controls the blooms of phytoplankton and so it can be hypothesised that a collapse of grazing pressure can result in a misbalance of the structure of the ecosystem.

The above conclusion was revisited during the discussion of *Tor g5* (Consider the scientific and operational merits of inclusion of primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes). Recommendations on sampling the zooplankton when monitoring eutrophication was already treated during last year's meeting of this Working Group. The group felt that there is a strong scientific support for the inclusion of a measure of primary production and zooplankton in eutrophication monitoring programmes because of the sensitivity of the organisms to changes in eutrophication status.

A presentation on the uses of "Smart Buoys" in recording near-real time environmental and phytoplankton data at two locations in the North Sea was used as an introduction to the ways of improving the phytoplankton and zooplankton components in GOOS (*Tor g4*). It was agreed that the cost of the equipment for automated measures implemented in moored lines strongly limits the use of such technology and so the spatial resolution needed for an ocean observation system is a long-term goal. In the short and midterms the bulk of the existing bio-ecological observations in oceanography are based on standard sampling programmes. After the discussion it was suggested that the Working Group on Zooplankton Ecology would approach the Euro-GOOS secretariat to offer the 1999–2000 Zooplankton Status Report as an example of a possible contribution to GOOS.

Finally, as a result of the discussion of the Oceanography Committee at the 2000 ASC, both Working Group on Phytoplankton Ecology and Working Group on Zooplankton Ecology discussed the advantages and disadvantages of merging into a new functional working group. A number of arguments were identified in support of the continued existence of the two groups as separate entities. Nevertheless, links between Working Group on Phytoplankton Ecology and Working Group on Zooplankton Ecology were discussed reflecting the desire of the Oceanography Committee for these groups to consider merging. An example was illustrated with a suggestion to collaborate in the future production of an annual status report on standard sections of plankton (phyto+zoo) in the ICES area based on the report produced annually by the Working Group on Zooplankton Ecology.

1 OPENING OF THE MEETING

The meeting was held at the Institute of Marine Research (IMR) at Bergen, from 26–29 of March at the kind invitation of Dr Francisco Rey and started at 09:15 on the first day. Participants were welcomed to Bergen by Dr Ole Arve Misund, Director, Centre of Marine Environment, IMR He summarised the facilities available at what is the largest marine research institute in Norway with a staff of 500. The staff include 120 seamen who operate the research vessels of the institute and 135 scientists. Plans to build a new research vessel to replace the *Geosars* based on the Norwegian design used for the Scottish vessel *Scotia* were outlined.

The meeting was attended by 8 members of the ICES Working Group on Zooplankton Ecology representing 5 countries (Annex 1).

2 ADOPTION OF THE AGENDA

The agenda for the Working Group on Zooplankton Ecology meeting (Annex 2) followed the terms of reference adopted as a resolution of the 88th Statutory Meeting in Bruges (C.Res. 2000/2C06). Plans for a joint meeting with the Working Group on Phytoplankton Ecology in the second half of the week was outlined at the beginning of the meeting.

The terms of reference are:

a) update results from Standards Sections and Stations and consolidate inputs from member countries into the Summary status report on the zooplankton monitoring structure in the ICES area.

b) continue with the discussion on the uses of biological indices and data produced in a routine basis for the fisheries and environmental assessment groups.

c) finalise the compilation of results, publications, and other material (video documentation of the work at sea, and images) from the June1993 Sea-going Workshop in Storfjorden and consider the edition of a CD-ROM to be distributed by ICES at a nominal charge.

d) report and evaluate the results of the workshop on taxonomy of calanoids held in Terramare (Germany) in 2000.

e) review and evaluate the advances in the organization of the ICES/PICES/GLOBEC Symposium.

f) prepare and formulate key questions requiring interdisciplinary dialogue for a possible joint meeting of the Oceanography Committee's Working Groups in 2002.

g) discuss in a joint meeting with the Working Group on Phytoplankton Ecology the following major topics of common interest:

- limits to modelling phytoplankton – zooplankton interaction
- how do characteristics of phytoplanktonic diet (size, morphology, physiological condition, toxicity) influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?. (Focussed to organism level when possible).
- can a collapse in grazing pressure lead to symptoms of eutrophication?
- ways of improving the phytoplankton and zooplankton components in GOOS
- Consider the scientific and operational merits of inclusion of primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes.

3 REPORT OF THE OCEANOGRAPHY COMMITTEE MEETING AT THE 88TH STATUTORY MEETING

The discussion of the Terms of reference was preceded by an introduction on the Oceanography Committee discussions during the 88th Statutory meeting. This included:

- A working-document collating the executive summaries of 9 Working Groups and 1 Workshop report was edited. This was considered a good initiative that allows the Working Group members to have a quick look on the work and discussions carried out by the other Working Groups. This will be maintained in the future. L. Valdés will prepare such summary for the Working Group on Zooplankton Ecology.
- For the second year Working Group Reports were peer-reviewed. The report peer-review process was discussed with agreement that it promoted a better report. Given the more critical nature of the reviews this year, some Chairs (e.g., Working Group on Zooplankton Ecology) requested earlier delivery of reviews in order that their Working Group could respond. In order to maintain a record of the reviews, next year it was proposed that they are published as a C document together with the Working Group's response and the executive summaries. It was further proposed that this year's reviews be posted on the web. The Working Group on Zooplankton Ecology discussed on the need for peer review of the work of the group, which was considered a useful exercise, but given the voluntary work by most members, publication of the peer review reports on the web as proposed by ICES was thought to be inappropriate.
- The review by the Oceanography Committee of the work of Working Group on Zooplankton Ecology noted the *extremely vigorous, energetic and productive nature of* the group. The group thinks that this productivity is a consequence of the focused nature of its work. The evolution of the group was outlined by looking at the list of *Tors* discussed since its foundation nine years ago. An outline of the deliverables achieved and in progress by the group is given in Annex 3. Possible ways in which the products of the working group could be made available to a wider audience and/or better publicised were discussed. Use of the ICES/GLOBEC newsletter and regular input to net sites such as Ocean net and Science net was raised.
- A subgroup on restructuring the Working Groups was convened on the perception that the discipline based Working Group structure needs reviewing and rationalising to conform with the ICES Strategic Plan. This subgroup suggested a proposal for fundamental restructuring. According to its proposal the existing disciplinary Working Groups should be phased out and replaced with two new types of groups: Limited-life Task Groups (convened to respond to particular requests for information) and Thematic programmes (to develop theory and application of disciplinary science to the integrated assessment of marine environment). The Working Group discussed this proposed fundamental restructuring, and the independence of its future within the Oceanography Committee structure (which was discussed at AOB section, see pages 15–16 of this report); we support the structure presented by the Working Group on Zooplankton Ecology at the Oceanography Committee during the 2000 ASC (Annex 4). The figure at Annex 4 outlines the current structure of the Oceanography Committee and its division into logistic, disciplinary and cross-disciplinary (functional) groups. It is noted that while functional working groups are needed to address questions posed to the Committee there remains a need for a core of single discipline, science-oriented working groups.
- The planned 2002 inter-Working Group Meeting was mentioned. It was agreed to await the outcome of the 2000/2001 discussion with respect to the Working Group structure before a decision is taken with regard to a joint Working Group meeting in 2002.

Finally the Chair noted that the actions proposed by the group at its 2000 meeting: (i) Publication of a web page on the Zooplankton Methodological Manual and (ii) Edition of the Zooplankton Status Report, were achieved on schedule.

4 RESULTS FROM STANDARD SECTIONS AND STATIONS: INPUTS TO THE SUMMARY STATUS REPORT ON THE ZOOPLANKTON MONITORING STRUCTURE IN THE ICES AREA. (TOR A)

The Chair made reference to the first "Zooplankton Monitoring Status Report" (ZMR) produced for the year 1999/2000 (Annex 5) and the good reception this had received. Ways in which the report for the year 2000/2001 could be improved without involving major new work were considered during the session.

Dr Sameoto summarised results for the Canadian Atlantic Zone Monitoring Programme (AZMP) and cited the website (zmpweb.dir\azmpd\zmp\centemap-zmp-ehtml) where much of the information is available in the form of data or graphs. The monitoring programme is used to help establish baseline data for both fisheries and climate change and was established in response to the Cod crisis. In the last five years the scale of observed environmental change has been as much as in the previous 50 years. Data from the CPR were averaged for two regions, one in the Irminger Sea and the other over the Scotian Shelf. Pronounced increases in winter colour and large drops in *Calanus* are evident in recent years and it was suggested that the evidence available indicates that the reduction in *Calanus* may be by a factor of up to 100 fold. It was noted that this reduction does not appear to have occurred further south on Georges Bank. Attention was drawn to the largest recruitment of the haddock and the biggest calving of the right whale on record in 2000; the cause is not known. Haddock also increased in the Gulf of Maine in 1998 and numbers have increased in the North Sea.

The factors that may have contributed to an Atlantic wide response by the haddock to possible environmental forcing and why the cod had not also responded were raised in discussion. A need for an improved sampling of the environment and plankton on fish stock assessment cruises and the difficulty of relating standard section data to the fishery was noted. Improvements in technology and software may make video plankton recorders and automated identification for real time measurements of plankton affordable in the near future. The associated skilled technicians needed to operate the equipment however, may still be expensive.

No information was provided by the USA for inclusion in the 1999/2000 report. Dr Wiebe informed the group that no standard sections were operated by the USA in the western Atlantic except for the MARMAP survey that took place six to eight times a year between 1978 and 1988 and that the datasets for these surveys were not available. CPR tows are also operated by NMFS in the Gulf of Maine and to Bermuda. Systematic sampling has also been undertaken over Georges Bank as part of the US GLOBEC programme. While not intended as a monitoring programme a summary of this data would be worth including in the ICES report. A Gulf of Maine Observing system is in process of being established. Dr Wiebe offered to contact the National Marine Fisheries Service for a contribution to the ZMR [PD note: last day of our meeting at Bergen a letter from David G. Mountain, National Marine Fisheries Service, was received offering information to the ICES Working Group on Zooplankton Ecology for its annual report on zooplankton monitoring. The data received include time series (1971–2000) of plankton displacement volume on Georges Bank at early spring and early autumn].

A discussion on ownership of data ensued. It was pointed out that six months after the completion of an EU contract the data is freely available to anyone. This is not enough time for the original workers to write up their papers and this breakpoint should be extended to a year. Access to data should also be a basis for collaboration. Reference was made to the SAHFOS data policy and data licence procedure that makes the data freely available to all and compliant with the developing data policy of GOOS. US GLOBEC data is also freely available when put into the databank. However, by etiquette any user is obligated to discuss their requirement with the originator and cite that person in any publication. The relevance of the ZMR is that the value of the data increases as each new dataset or section is added. Data is needed from all around the Atlantic basin to see how patterns of change are varying.

Then the Working Group commented on specific sections of the 2000 ZMR The Icelandic part should be rearranged to present the longest time-series first. The CPR section will be revised by Dr Reid including new figures with *Calanus finmarchicus* abundances given for SAHFOS statistical areas. He will also consider including *C. helgolandicus* in this years report. The Norwegian section must include all available years in the time-series data of the standard sections. Dr Melle will consider how to include time-series data from basin wide mappings of zooplankton biomass. From the North Sea the Stonehaven data by the Marine Laboratory, Aberdeen, were the only data given in the 2000 Status report. This year report should include data from the fixed station off the Northumberland coast (Dove permanent Station, [PD note: these data were already received]), and data from the fixed station off Helgoland (Dr Wolf Greve, Germany).

In some cases more than one area is covered per country. Each area should consist of one page with a brief descriptive text, followed by a diagram illustrating interannual patterns of change (when possible), one reference (the most up-to-date) and when available the web site. To help evaluate the situation in the last year of sampling the data should be plotted on each graph with a horizontal line showing the position of the long-term mean. All graphs should be plotted to

the same time scale starting with the longest, excluding CPR data, which should be presented separately at the end of the document.

The group then addressed the gaps in the report of last year from other missing contributions. It is hoped that the coverage of the report can be improved each year by adding additional contributions with at least one page for each ICES country. The group strongly recommended that each nation should give a metadata description of what zooplankton monitoring data is available. The chair will write to all ICES delegates requesting a national contribution. To help stimulate a response for next years report each ICES country will be given a heading and a quarter or fifth of a blank page if no data is provided with the text **No data provided** will be inserted. It was felt that phytoplankton data and reference to HAB monitoring should also be included (possibly next year) and that this possibility should be raised at the joint meeting with the Working Group on Phytoplankton Ecology later in the week. Some results of satellite monitoring might also be included in future versions of the report.

In summary, several improvements of the ZMR were suggested: To include Russian data as well as data from other ICES countries, to summarise all time series on a common time scale starting in 1960 (CPR data on a separate scale, though), give data as numbers or biomass per m^2, include depth of sampling (or integration depth), and give long term mean. In the Background section of the report differences in units and methods of sampling must be stated. The Status report should include a table listing the countries that have been contacted to deliver data, as well as blank quarter pages clearly showing the countries that did not contribute. The Chair will write a letter to all the ICES countries with the 2000 Status report attached and ask for zooplankton monitoring data.

The general layout for the year 2000/2001 report should be: Text with ecological interpretation, figures, references and web site address. If possible data should be available at the web site. Otherwise, one should refer to the Metadata table. The Metadata table should be rearranged to give nations as the header of each column, and the table should also give the web site addresses.

5 USES OF BIOLOGICAL INDICES AND DATA PRODUCED IN A ROUTINE BASIS FOR THE FISHERIES AND ENVIRONMENTAL ASSESSMENT GROUPS (TOR B)

The use of biological indices and data produced on a routine basis for the fisheries and environmental assessment groups (*Tor b*) is today a priority within different panels and agencies (US GLOBEC, SPACC[1], ICES, DFO, etc.). In 1999 the Working Group decided to be proactive on this discussion. In a previous meeting we discussed how we can incorporate biological information into the assessment process. This year the discussions were focussed on the identification of first order ecosystem variables included in local and global monitoring programmes that could be implemented into the assessment process.

Dr Sameoto informed about the Canadian approach where a table of 15–20 environmental indices have been collected to search for correlations and overall trends (see Working Group on Zooplankton Ecology Report, 2000). The initial number of indices will be reduced to about 10 key indices that should reflect ecosystem health and have predictive power for fisheries assessment.

Dr Reid mentioned that in the North Sea Phytoplankton Colour index (the colour on the CPR gauze from phytoplankton) and the first PCA axis of the species composition in CPR samples was closely related to changes in the ecosystem. He also mentioned that *Calanus* abundance may be a good index for fish recruitment and valuable for fisheries assessment.

Dr Wiebe stated that *C. finmarchicus* is the most important zooplankton species for the fisheries in the North-Atlantic. There was a general agreement that *C. finmarchicus* abundance or zooplankton biomass are good biological indices of ecosystem health and useful for fisheries assessment in the northern North-Atlantic.

This was followed by a brief discussion on the value of multivariate indices to encapsulate the true variability of environment, e.g., in southern regions not one but several species tend to dominate the zooplankton community, which calls for multivariate analyses to create a representative zooplankton index. Dr Sameoto mentioned that species ratios might be useful as indicators of environmental change.

[1] Dr. Valdés informed about a SPACC activity on the "Use of environmental indices in the management of pelagic fish populations", which has programmed 3 meetings in the next two years (starting in 2001). A total of 10-12 experts will be selected on the basis of their past and present work and commitment to SPACC and GLOBEC activities.

The Working Group then addressed the use of combined physical and biological indices for ecosystem health. Dr Hay suggested that one should concentrate on the indices that could be drawn from the zooplankton monitoring. He continued that biochemistry of zooplankton and measurements of biological rates (e.g., egg production) should be built into the indices. It may be difficult, though, to obtain biological rates on a basin scale. Dr Sameoto pointed to the importance of the timing of biological events as an indicator of ecosystem change.

The course of the discussions evidenced the complexity behind the selection of "simple environmental indices". To accomplish this, a list of indices of potential value for understanding zooplankton dynamics and ecosystem functioning was produced (the list is open to new items) and distributed among the group members, who were demanded to score them. This scoring procedure for environmental properties with ecological significance render the results shown in Annex 6. Of course this does not represent a complete list of important ecological properties but may be used as a starting point for further discussions.

This *Tor* was considered to have high relevance for the group and further discussions on the selection, interpretation and validation of these indices need to be continued before clear conclusions can be achieved.

6 COMPILATION OF RESULTS, PUBLICATIONS, AND OTHER MATERIAL FROM THE JUNE 1993 SEA-GOING WORKSHOP IN STORFJORDEN (TOR C)

The compilation of results from the June 1993 Sea-going workshop has been in the Working Group on Zooplankton Ecology agenda since 1998. After years of effort the objective has been achieved and a set of 4 CD-ROM is now available for the scientific community.

Peter Wiebe presented a brief review of the aims of the sea-going workshop along with an outline of the location of the experiment, the experiment design, types of sampling gear used and the various sampling method comparisons made. The experiment included a wide variety of sampling nets as well as the electronic OPC and a variety of acoustic devices (Annex 7). A description of the two vessels (R/V Hjort and R/V Humbolt) was given as well as the sampling methods carried out on each vessel. A daily chronological review was given for the various activities during the experiment that included the sampling experiments and depths at which sampling occurred (Annex 7).

Some of the results from the net comparisons were shown in the form of biomass plots with depth. A list of the types of data collected included physical, biological, chemical and acoustic data. These data will all be included on the CD-ROM set that Peter is producing describing the experiment and its results. A manuscript is almost complete that includes about 95 % of all the data collected during the experiment, missing are the OPC and CPR sample data. The CPR data are believed to be at SAFHOS, and Chris Reid said that once the samples were located that they would be analysed as soon as possible.

A layout of the format of the CD-ROM was shown that included the planning document of the experiment. The CD-ROM will be produced in hypertext that will link up all the data collected. It is estimated that four CD-ROM will be needed for the entire experiment and results: Methods and Results (1 CD), Acoustic data (2 CDs) and Video images on the use of plankton gears at sea (1 CD).

Information about the ship, gear, and station will be associated with all the data. Data will include species lists, counts, biomass, and type of nets used to collect samples plus the name of the research groups that did the identification of the samples. Length/wet weight data for the macrozooplankton species was included on the CD-ROM. Phytoplankton species counts were included along with the methods used in collecting these data. All the data will be available in both excel spreadsheets and ASCII text format. A suggestion was made that a section be included for the miscellaneous sampling instruments that were used but not included in the final analysis.

It was suggested that a master file needs to be made that will relate the various observations to the type of gear used to collect the information. There also should be a reference to the gear type in the zooplankton manual along with a page number for a reference in the manual.

A sponsor for the production of the CD-ROM set is needed; it was suggested that ICES or GLOBEC money might support this effort.

Peter Wiebe would like his book on the history zooplankton sampling gear to come out at the same time as the CD-ROM set, but he will not wait for the book before producing the CD-ROM set. It is hoped that by releasing all the data on the CD-ROM set a change of attitude among other researchers about sharing unpublished data may result. Roger Harris thought that Academic Press may still be interested in including the CD-ROM set with a new version of the

zooplankton manual. Luis Valdés suggested that ICES might want to produce a limited number of the CD-ROM set because it was a workshop under the auspices of ICES and they would like to see a product from this experiment.

The CD-ROM set will be finished by the end of June 2001, and distributed to the Working Group members for review. It is planned to have a CD-ROM set ready for discussion at the Oceanography Committee during the ICES ASC

The members of the group acknowledged the effort required for the compilation of these results and it was proposed that the four CD-ROM set should be offered to ICES for wider distribution.

7 RESULTS OF THE WORKSHOP ON TAXONOMY OF CALANOIDS HELD IN TERRAMARE (GERMANY) 14– 17 MAY 2000 (TOR D)

Introduction:

Luis Valdés introduced the discussion on this topic by reporting that he had received an extensive report (section on Conclusions and Recommendations is presented in Annex 8) on the outcomes of this workshop from its main organiser Heino Fock, who's career has since moved away from direct involvement in taxonomic work. Luis noted this as an example of how experienced taxonomists were often lost to the zooplankton community, describing again the continued concerns of the Working Group on Zooplankton Ecology about the loss of taxonomic expertise within the ICES zooplankton community. Based on the proposal by Dr Heino Fock in 1999 it had been decided to carry out a workshop on zooplankton taxonomy in 2000. The workshop objectives were defined to be:

- To improve and intercalibrate the present taxonomic knowledge among scientist,
- To recommend, strength and initiate further taxonomic research
- To review existing identification keys for the North Atlantic area of ICES.

Drs. Heino Fock (Germany), Steve Hay (UK) and Luis Valdés (Spain) were appointed as organisers. The workshop was very generously funded by the German Science Foundation and was hosted by the Research Institute TERRAMARE (Willhelmshaven, Germany) courtesy of Dr Gerd Liebezeit, during 14–17 May 2000. The group extends its warm thanks to the hosts, supporters and organisers, particularly Heino Fock who did almost all the work, of what proved to be a successful, enjoyable and constructive workshop.

Invitations were sent to most of the ICES marine research laboratories and personal letters were also distributed to a large mailing list of planktologist covering all the ICES countries. Participation was free of charge, and travel and subsistence costs of invited experts and 1 student were covered by the organization. Four recognised experts were expressly invited: Ann Bucklin and Penelope Lindeque (both experts in applying genetic techniques to calanoid copepods), and Elena Markhaseva and Knud Schulz (professional plankton taxonomists with particular expertise on copepoda). The Working Group also extends its gratitude and appreciation to these four experts for their hard work and enthusiastic participation and patient instruction during the workshop proceedings. Aside from the four invited experts, the workshop was attended by: Heino Fock, Sigrid Schiel, Lutz Fischer, Sabine Grabbert, R. Böttger-Schnack, Tanja Jonas, John Fraser, Steve Hay, Elisabetta Broglio, Luis Valdés, Mª Luz Fernandez, Maite Alvarez-Ossorio, Kunigunde Hülsemann, Dirk Mengedoht

Summary

The workshop focused on the Calanoid copepoda.

For the **Molecular Genetics Session** following terms of reference were agreed on:

1) to discuss the applicability of new techniques for the analysis and determination of populations for routine and research purposes
2) to discuss conjoint initiatives in this particular field and opportunities of support for running programs
3) to evaluate the new techniques and to give recommendations whether to establish and routinely apply these techniques in future monitoring and research programs
4) to discuss the applicability of world-wide or regional coding systems under the light of genetic variability (e.g., ITIS)

The lecture session was opened by Ann C. Bucklin, introducing in a delightfully clear and interesting way, the field of molecular systematic and population genetics. Further excellent presentations were made by Pennie Lindeque and Dirk Mengedoht.

TOR 1) Ann Bucklin and Pennie Lindeque pointed to the rapid development in the field of science. These techniques are helpful and sometimes indispensable in areas where closely related species overlap and can hardly be distinguished (e.g., *Calanus glacialis* and *C. Finmarchicus* in Lurefjord/Norway). In a similar way the *Nannocalanus minor*-group will be resolved, which at present is separated into a forma *major* and f. m*inor*-group.

TOR 2) As a new initiative, Ann Bucklin and Pennie Lindeque proposed to create a database on genetics for Atlantic copepods, as a reference tool and basis for future comparative analysis. Those present agreed to make efforts to assist by providing sample specimens, preserved in glass vials, from fresh, into >10x excess 95% analytical grade ethanol, acidification and chemical contamination to be avoided.

TOR 3) New techniques will provide opportunities not only to do qualitative, but also quantitative determination of samples. At present, a modified polymerase-chain-reaction is being developed. As further progress, identification and quantification by means of chip technology with multiple species probes are possible.

TOR 4) A specific coding system was introduced by Steve Hay and discussed in relation to the assembled species lists, the need for updating in many such lists and for establishing standards and revision protocols. The initiative shown in the ERMS project checklist was considered an excellent work as were the efforts of the ETI group at the University of Amsterdam. Genetic variance in sibling species was discussed, but no recommendation developed. It was noted that few full descriptions of all developmental stages of copepods were available. Also there is a strong need for computer coding systems to include development stage and size, weight etc. as an integral part of taxonomic coding to allow "ecological" taxonomists to more easily use standard lists.

For the Morpho-taxonomical Session the following terms of reference were proposed:

5) to update taxonomical information for the different taxa,
6) to present examples from the different regions, to compare typical and critical material,
7) to discuss difficulties in determination,
8) to evaluate determination keys and give recommendations for new editions of keys,
9) to discuss standards for presenting data concerning size and age classes, developmental stages etc.,
10) to provide data for regional species checklists and discuss and compare them with published faunas and specific distribution ranges.

The sessions were introduced, with enthusiasm and displays of their extensive skills and knowledge, also considerable patience with puzzled participants, by Elena Markhaseva and Knud Schulz.

TOR 5–7) Results include a review of key taxonomic characteristics for identification of main genera and species and comparison of species at different ICES regions. This is summarised at the "Annotations to the checklist" in the full report.

TOR 8) A list with newly published and recommended references is presented in 'Literature and references section' of the full report. The participants also agreed to ask Alistair Lindley, as editor, to comment on the status of the ICES Identification leaflets (action H. Fock).

TOR 9) This was briefly discussed, but no recommendation developed.

TOR 10–11) Preliminary regional checklists were provided and discussed, their construction and collation is a major effort and is not completed yet. The Sir Alister Hardy Foundation intends to publish an atlas of regional distribution maps for zooplankton. An example chart is given in the full report.

Conclusions and Recommendations from the workshop are given in Annex 8.

Working Group on Zooplankton Ecology Evaluation

At this review of these workshop proceedings in the Working Group on Zooplankton Ecology meeting, Steve Hay and Luis Valdés commented on the proceedings and both reinforced to the Working Group the satisfaction and practical benefit they and the other participants had achieved through attending. There followed some more general discussion on the scarcity of taxonomic expertise and resources and the benefits to be gained from further pursuit of the workshop objectives. It was then proposed and accepted that the group should accept the workshop recommendations (Annex 8).

Further discussion again highlighted the example of a course in zooplankton taxonomy organised by The Zoological Museum in Amsterdam in cooperation with ETI Biodiversity Center, University of Amsterdam, as illustrating demand and interest in training on zooplankton taxonomy. Dr Matthijs van Couwelaar from ETI had wished to attend this Working Group meeting to discuss his efforts to generate an illustrated guide to the plankton of the North Sea. Unfortunately he was at sea, so unable to attend, but he remains keen to participate in future.

It was also noted that Russia, Poland, Lithuania and other countries still retained and fostered traditional training and expertise in taxonomy. Indeed a number of research programs in the US and the EU countries had made considerable use of these skills by sending sample sets for analyses, to Poland in particular. This has achieved considerable cost savings and made use of the retained skills in Poland. The relatively inexpensive per sample rates for such analysis, have disadvantages. There has been erosion of skills in the west and there are some doubts as to the quality of analysis provided by individuals with little or no direct connection or appreciation of the projects where the samples are collected. Plankton species and communities usually differ between regions and the specialist literature, expertise and experience of analysts working in particular regions may not always be duplicated by analysts from elsewhere. It was also remarked that there is an extensive Russian literature on global zooplankton taxonomy, which remains largely inaccessible to western experts. There is too the fact that very considerable data on plankton distributions around the world's oceans and seas remains locked in Russian archives.

Dr Alistair Lindley, the current editor of the ICES FISCHES Plankton Identification Sheet series, has recently composed a summary document (i.e., Plankton leaflet No. 187♠) titled: "Numerical and Taxonomic Index of ICES Plankton Identification Leaflets, 1939–2000". This was presented to the Working Group by Dr Chris Reid of SAHFOS and discussed. It was proposed that a simple solution to difficulties with the paper format, i.e., availability, needs for regular revision and overall cost of these valuable sheets, would be to convert them to CD-ROM format. By simply converting the summary to an HTML document with "hot links" to a compendium of scanned sheets, this could be achieved very quickly and at very little expense. The result would be a saving in the publication expense easier storage, delivery and enhanced dissemination at reduced cost of a much more effective product. It was agreed that Dr Reid would in concert with J Lindley prepare a demonstration CD-ROM to show to the Council and ICES administration whose approval for such a change of format must be sought by the Working Group. The ultimate objective is that ICES could offer such product to a larger community of scientists.

Given the success of this Taxonomic Workshop and current developments and plankton research directions the group felt that a further workshop should be considered in the coming year to be held in two years. SAHFOS offered its premises to hold the workshop and the group accepted its invitation (SAHFOS is widely recognised for its excellence in plankton taxonomy and possesses the facilities necessary for holding such a workshop).

8 ORGANIZATION OF THE ICES/PICES/GLOBEC SYMPOSIUM (TOR E)

Roger Harris introduced the discussion on this topic by reporting the background and the current advances regarding this international symposium. He remembered that the initial proposal was developed by the PICES Biological Oceanography Committee and the PICES-GLOBEC Climate Change and Carrying Capacity (CCCC) Program. This draft was introduced at the ICES Working Group on Zooplankton Ecology meeting, held jointly with PICES colleagues in Hawaii. Based on discussion at and subsequent to this meeting, the proposal was modified slightly to reflect a preferred date of 2003, the composition of the Steering Committee, title, etc.

Negotiations after the Hawaii meeting agreed in the title "*The role of Zooplankton in Global Ecosystem Dynamics: Comparative Studies from the World Oceans*" which reflect the global dimensions of zooplankton ecology. A venue in Europe was considered to be most appropriate to link the ICES and PICES communities.

♠ This report was presented for review to the Working Group prior to last year's meeting.

The Working Group included for consideration of the ICES Consultative Committee a draft resolution with all the supporting information and with a clear remark on the high priority that such initiative should have for ICES. This resolution was approved by ICES at their 88th Statutory meeting in September 2000 (Res. 2CSY01). Similarly, it was approved by the GLOBEC Scientific Steering Committee at their meeting in June 2000, and by the PICES Governing Council at the PICES Ninth Annual meeting in October 2000.

The Symposium will have three Convenors representing the three sponsors. Dr Roger Harris (Chair, GLOBEC Scientific Steering Committee) was nominated by GLOBEC and Dr Tsutomu Ikeda (Chair of the PICES Biological Oceanography Committee) by PICES.

The practical planning for the Symposium will be conducted by a Steering/Organising Committee consisting of two members from ICES, two from GLOBEC (Drs. Roger Harris and Serge Poulet), and two from PICES (Drs. Tsutomu Ikeda and Willian Peterson).

ICES had asked the Working Group on Zooplankton Ecology to elect two ICES representatives to the Steering Committee. This was done during this meeting and Dr P. Wiebe and Dr L. Valdés were nominated as ICES members on the Steering/Organising Committee of this Symposium; the Working Group on Zooplankton Ecology also consider that Dr M. Tackx should be included as convenor (as she do not attend this meeting the group will approach her as soon as possible♣).

With respect to the dates and venue, it was considered the spring of 2003 as the best option and a three days symposium as the proper duration. A Belgium offer of hosting the Symposium at Bruges was received at ICES Secretariat and it was consider as a good venue. If a formal compromise cannot be reached soon, then the group will explore a second offer of hosting the Symposium at Gijón♦ (Spain).

It is expected that the meeting will result in the publication of the best papers in a special issue of an international journal. ICES secretariat was consulted in relation to the publication of a special issue of the *ICES Journal of Marine Science*, which could be a significant ICES contribution to support the Symposium. A decision will be taken soon.

In summary most of the preliminaries have been completed successfully, and the others will be decided very soon. Once that these final details are solved, all the information will be passed to the Convenors and the Steering/Organising Committee, who should continue with the definitions, scope, themes, sessions, examples of suggested contributions, financial support, etc. It was suggested that the First Announcement should be finalised by late spring/early summer 2001 (in time for distribution at various annual meetings).

9 KEY QUESTIONS REQUIRING INTERDISCIPLINARY DIALOGUE FOR A POSSIBLE JOINT MEETING OF OCEANOGRAPHY COMMITTEE WORKING GROUPS IN 2002 (TOR F)

The group recognised that the joint meeting of the Oceanography Committee's Working Group in 2002 would be an opportunity to discuss topics of common interest. But the decision of the Oceanography Committee to delay any joint meeting of the Working Groups until a review of their collective status had been completed, lessened the main objective of this Tor.

It was discussed first if we should re-addressed this Tor for the searching of key questions requiring interdisciplinary dialogue as topics for Theme Sessions for the next 2–3 year ASC. R. Harris and P. Wiebe suggested some discussion about the need for dialogue might be useful to the group even if the pressure to do so was off. It was decided by the group to carry out a discussion of the topic.

Steve Hay opened the discussion by referring to a document that he had prepared prior the meeting in which he put forth questions that he thought needed to be addressed in a joint meeting and dialogue involving all of the Working Groups (Annex 9). S. Hay said that there are a substantial number of Working Groups within the Oceanography Committee's purview and the theme session approach at the annual meeting is an effective way to foster integration of the work of the groups. Theme sessions that bring together different Working Groups would be useful.

♣ After the meeting Dr. M. Tackx was approached and she said that she has moved away form Belgium. She excused her participation as convener and/or member of the Steering Committee.

♦ As the Belgium offer was not firm and Gijón was formally offered as venue. ICES, PICES and GLOBEC accepted this venue and the dates were fixed for the 21-23 of May 2003.

Then the Working Group commented on specific sections of the Steve Hay's document. S. Hay said that relative to the questions he posed to the ICES/GLOBEC Working Group on Cod and Climate Change, he would like to see regional changes linked to climate change data. He thought that the cod and climate change outputs needed to be more broadly discussed. He used as an example the fact that it now appears that Haddock had good years in 1998 and 1999 across the North Atlantic ocean basin and asked if this should be the focus of a theme session or a workshop. There was support for the notion that an exceptional year did occur in many areas on both sides of the Atlantic, but that some specific information produced by W. Melle at the meeting about Norwegian haddock (1988 was not exceptional, but there was no data yet on 1999) caused some to questions to be raised about which years were really exceptional. While the need for additional information about this topic was apparent, a more fundamental question was posed as the basis for a theme session. Are there changes in secondary production which give rise to exceptional year classes of important fish stocks such as haddock? The topic has obvious links to the search for indices of potential value in understanding zooplankton dynamics. L. Valdés also reiterated the fact that he wanted to link the issue of exceptional fish recruitment to the issue of the development of indices since the two were strongly related.

C. Reid suggested a theme session which addressed the topic of the contributions of shelf edge inputs to the shelf seas and their importance to the shelf ecosystem both physically and biologically. He said this was an area in shallow sea biology that has been ignored to some extent recently. After a brief discussion, the proposal for a theme session was formulated as: Flows into shelf seas from ocean boundary currents: hydrobiological implications and effects on fish stocks.

C. Reid noted the problems in dealing with the mero-plankton in the shelf sea ecosystems. There is a lack of good ways to identify the various species and as a result they are often ignored in plankton studies. This is a missing link in coastal plankton research, an open research area, and also a benthic-related problem because interactions between the water column and the sea floor contributes to the benthic spawning stock and benthic production. However, linking the water column to the benthos is difficult because of a lack of information about nutrient regeneration by the benthos and inputs to the bottom by the water column. S. Hay suggested a theme session associated with the question that has developed from this discussion: "What are the pathways from plankton production through the benthos to fisheries?" Additional discussion resulted in the suggestion that this idea be held back and reintroduced as a possible theme session for 2003.

L. Valdés noted Key questions identified in last year's report, and he thought that these should be integrated into theme session proposals. The issue on What have we learned from the time series programmes? should be of interest. A major point is that they are complex data, often-requiring comparative analyses and correspondences to be established with "far field" or external data to interpret findings. Joint revision, with other Oceanography Committee groups, of monitoring activities carried out in the different working groups, and of how these may be presented on the web or otherwise made more accessible. R. Harris said the focus should be on relating time-series of zooplankton with temperature, salinity, and phytoplankton and benthos data generated by other groups so that there was an integration across the boundaries.

R. Harris suggested that a theme session on ecological theory would be desirable. S. Hay pointed out the lack of theoretical ecological papers which use marine ecosystems as their test beds. A possible theme might be "Current understanding and next steps in zooplankton ecological theory" or "Theoretical concepts in ecological understanding: theory and practices in marine ecosystem studies". S. Hay indicated that most researchers dealing with this issue are theoretical ecologists and fisheries, population dynamics, and ecosystem modellers. In this regard, he mentioned John Steele and Mike Heath. He also remarked on a study recently started which employs a stoichometric approach to ecosystem analysis, and links growth dynamics to biochemistry and genetics from cells to whole organisms. Unfortunately, this study is aimed at the terrestrial and freshwater aquatic systems and not to the marine environment. This approach should be included in a theme session on this topic since he feels it will give rise to relevant ecological theory.

In summary, five titles were selected after a discussion on main interest and priorities of this group. Two of them will be addressed as Theme Session for the 2002 ASC and the others will be postponed for future ASC. The choices for 2002 were:

- Environmental conditions in extraordinary fish stocks year classes (e.g., haddock) [alternative wording: Are there changes in secondary production which give rise to exceptional year classes of important fish stocks such as haddock?]
- Flows into shelf seas from ocean boundary currents: hydrobiological implications and effects on fish stocks. Co-Conveners: Dr Philip (Chris) Reid (SHAFOS; Plymouth, UK) and Dr Einar Svendsen (IMR; Bergen, Norway)

Drafts of the proposed theme sessions will be prepared in time for discussion during the Oceanography Committee meeting at the 89th Statutory Meeting.

10 JOINT MEETING WITH THE WORKING GROUP ON PHYTOPLANKTON ECOLOGY (TOR G)

The joint meeting was held at the Institute of Marine Research (IMR) at Bergen, 28–29 of March and was attended by 8 members of the ICES Working Group on Zooplankton Ecology representing 5 countries and by 9 members of the Working Group on Phytoplankton Ecology representing 8 countries (see Annex 10 for details). Dr David Mills was in charge of conducting the sessions and he mentioned that the joint meeting was largely demanded and that it is very welcome and timely. The development of working links between both groups has been mentioned frequently in the past and this was an excellent opportunity to tackle an agenda of common interests. The agenda was discussed at the last year meetings of both groups and included:

g1. Limits to modelling phytoplankton – zooplankton interaction.

g2. How do characteristics of phytoplanktonic diet (size, morphology, physiological condition, toxicity) influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?. (Focussed to organism level when possible).

g3. Can a collapse in grazing pressure lead to symptoms of eutrophication?

g4. Ways of improving the phytoplankton and zooplankton components in GOOS.

g5. Consider the scientific and operational merits of inclusion of primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes.

Both groups recognised the ambitious agenda and the difficulties to reach clear conclusions. In this section only a summary of the discussions is presented. The full detail of the discussions is included as Annex 10.

The discussion on the "Limits for modelling phytoplankton-zooplankton interactions" (*Tor g1*) and "How do characteristics of phytoplankton diet influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?" (*Tor g2*) were shown to have many points in common and we recognised that the bottlenecks must be solved in conjunction with specialist in modelling. A proposal for organizing a Workshop in modelling in 2003 was launched, and a Term of Reference addressed to prepare such workshop will be included in both Working Groups for the 2002 agenda.

The *Tor g3* "Can a collapse in grazing pressure lead to symptoms of eutrophication?", was discussed from a theoretical approach and illustrated with a few field examples (Narragansett Bay and North Sea). The conclusion was that there is evidence that grazing pressure controls the blooms of phytoplankton and so it can be hypothesised that a collapse of grazing pressure can result in a misbalance of the structure of the ecosystem.

The above conclusion was revisited during the discussion of *Tor g5* (Consider the scientific and operational merits of inclusion of primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes). Recommendations on sampling the zooplankton when monitoring eutrophication was already treated during last year's meeting of this Working Group. The group felt that there is a strong scientific support for the inclusion of a measure of primary production and zooplankton in eutrophication monitoring programmes because of the sensitivity of the organisms to changes in eutrophication status.

A presentation on the uses of "Smart Buoys" in recording near-real time environmental and phytoplankton data at two locations in the North Sea was used as an introduction to the ways of improving the phytoplankton and zooplankton components in GOOS (*Tor g4*). It was agreed that the cost of the equipment for automated measures implemented in moored lines strongly limits the use of such technology and so the spatial resolution needed for an ocean observation system is a long-term goal. In the short and midterms the bulk of the existing bio-ecological observations in oceanography are based on standard sampling programmes. After the discussion it was suggested that the Working Group on Zooplankton Ecology would approach the Euro-GOOS secretariat to offer the 1999–2000 Zooplankton Status Report as an example of a possible contribution to GOOS.

Finally, as a result of the discussion of the Oceanography Committee at the 2000 ASC, both Working Group on Phytoplankton Ecology and Working Group on Zooplankton Ecology discussed the advantages and disadvantages of merging into a new functional working group. A number of arguments were identified in support of the continued existence of the two groups as separate entities. Nevertheless, links between Working Group on Phytoplankton Ecology and Working Group on Zooplankton Ecology were discussed reflecting the desire of the Oceanography Committee for these groups to consider merging. An example was illustrated with a suggestion to collaborate in the future production of an annual status report on standard sections of plankton (phyto+zoo) in the ICES area based on the report produced annually by the Working Group on Zooplankton Ecology.

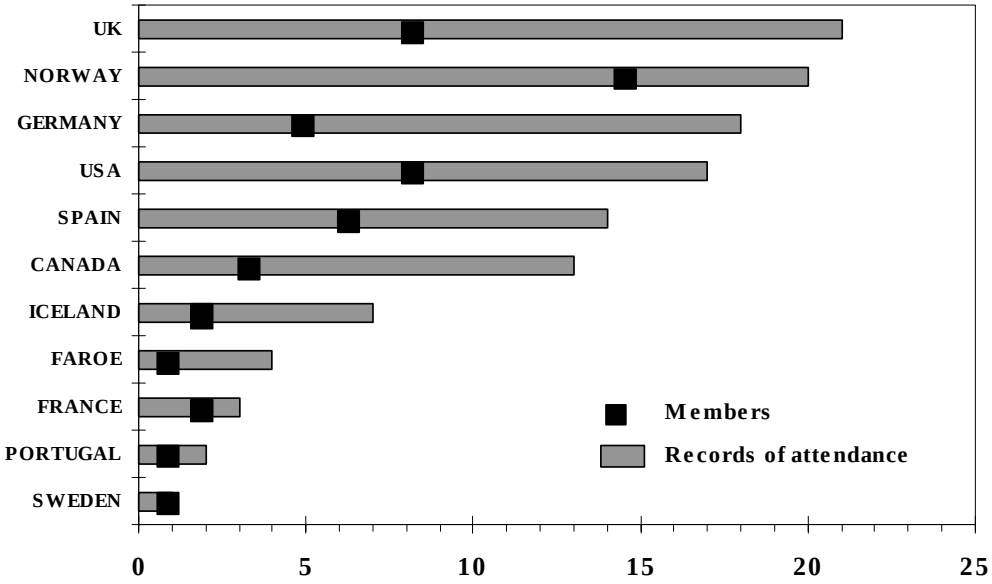
11 ANY OTHER BUSINESS

Two main points were covered in this section. The first was related to this year low attendance at the meeting, and the second was the discussion on the maintenance of this group as a disciplinary group within the structure of the ICES Oceanography Committee.

Concern was expressed over the low attendance at the meeting. The chairman explained that the list of members provided by the ICES Secretariat was found very inappropriate. It contains names of scientists outside the ICES area, names of scientist that never have attended this meeting, and even the name of an (unfortunately) dead person (Dr Michael M. Mullin). Among the long-standing members that use to attend this meeting 6 of them excuse their attendance due to research at sea or due to difficulties in obtaining travel funds.

The group felt strongly that delegates to ICES should ensure that representatives from their country are tasked, funded and encouraged to attend the working group. While many ICES countries have been well represented on the working group some countries have a poor record for attendance (see Figure 1).

Figure 1. Records of attendance at the Working Group on Zooplankton Ecology by ICES countries.



A proposal for fundamental restructuring of the Oceanography Committee is currently under discussion. This is based on the perception that the discipline based Working Group structure needs reviewing and rationalising and conforms to the ICES Strategic Plan. According to this proposal the existing disciplinary Working Groups should be phased out and replaced with two new types of groups: Limited-life Task Groups (convened to respond to particular requests for information) and Thematic programmes (to develop theory and application of disciplinary science to the integrated assessment of the marine environment). As the disciplinary Working Group that we represent, there was strong antipathy to the possibility of phasing out the group, for the following reasons:

- While participation in the Working Group on Zooplankton Ecology meeting was low this year much was achieved by the members during the year and over the last nine years since the group started. An outline of the deliverables achieved and in progress by the group is given in Annex 3. In particular, publication of the zooplankton methodological manual was a major achievement and a report on the laboratory and seagoing workshops with an associated set of CD-ROM will be published this year.
- Through its network the group has an important role in compiling the new annual reports on zooplankton monitoring results in the ICES area. ICES is committed to producing these reports which are likely to be of considerable value to the EU and national governments in assessing environmental change on a regional scale. The reports will also strengthen the advice that ICES can give on environmental change and contribute to GOOS. The membership of the group working together with a common interest makes the production of these reports possible.

- Interest in zooplankton research and its application to fisheries and environmental issues in ICES would decline.
- Last year review by the Oceanography Committee of the work of Working Group on Zooplankton Ecology noted the "extremely vigorous, energetic and productive nature of" the group; this productivity is a consequence of the focused nature of its work.
- Working Group on Zooplankton Ecology is the only single disciplinary international group working on zooplankton in the world and the products of its work have wide use both within and outside the ICES community. If the group was closed down ICES would lose the international recognition that the group currently brings to the organisation and there would be a need for a new group to be established under some other auspices.
- The group wants to make clear that it covers research activities and technical discussions on micro, meso and macroplankton as well as benthic meroplanktonic larvae and icthyoplankton. To emphasise this point it is recommended that the title of the group change to the Working Group on Zooplankton and Ichthyoplankton Ecology.

12 ACTIONS, RECOMMENDATIONS AND DRAFT RESOLUTIONS

Actions for the Working Group on Zooplankton Ecology

The group will continue working inter sessionally for the achievement of the following actions and deliverables:

Action I

The annual edition of a Summary status report on the zooplankton monitoring results in the ICES area is to be considered a priority for the Working Group on Zooplankton Ecology. The second issue will be improved with new information and it will be edited in time for the 89th ICES Statutory meeting. It will be distributed via the ICES web site and in the Working Group annual report.

Justification

The ICES Strategic Plan recognised the ICES role in making scientific information accessible to the public in addition to the fisheries and environmental assessment groups. It is also recognised the opportunities that the electronic media offers in terms of maximising the distribution of information to a wider audience.

Action II

A four CD-ROM set compiling the 1993 Sea-going workshop will be finished by the end of June 2001, and distributed to the Working Group members for review. It is planned to have a CD-ROM set ready for discussion and demonstration at the Oceanography Committee during the ASC.

Justification

The Seagoing Workshop has been a very valuable product of the ICES Working Group on Zooplankton Ecology. The compilation of information produced during and after this WS is recognised to be useful because the collective value of data is greater than its dispersed value, for dissemination of the results among a wide range of users from scientific and educational communities and to ensure that the data collected are conserved for future reference, and in consequence very appreciated. The four CD-ROM set will be offered to ICES for wider distribution.

Action III

A scanned version of the plankton leaflets published by ICES since 1939 will be produced. All the fiches will be linked by a numerical and taxonomic index (i.e., Plankton leaflet No. 187). A first version of a demonstration CD-ROM (with a dozen of leaflets) will be presented during the 2001 ASC.

Justification

The Working Group on Zooplankton Ecology supported the conclusions of the workshop on taxonomy and recognises the opportunities that electronic media offers in terms of maximising distribution of information to the scientific community. The ultimate objective is that ICES could offer this product to a larger community of scientist.

Recommendations to the Oceanography Committee

Recommendation I

The Working Group on Zooplankton Ecology recommends the support of the following Theme Session at the ICES ASC 2002:

1) Environmental conditions in extraordinary fish stocks year classes (e.g., haddock) [alternative wording: Are there changes in secondary production which give rise to exceptional year classes of important fish stocks such as haddock?].
2) Flows into shelf seas from ocean boundary currents: hydrobiological implications and effects on fish stocks. Co-Conveners: Dr Philip (Chris) Reid (SHAFOS; Plymouth, UK) and Dr Einar Svendsen (IMR; Bergen, Norway).

Drafts of the proposed time sessions, convenors and other logistic details will be prepared for discussion during the Oceanography Committee meeting at the 2001 ICES ASC.

Draft resolutions to ICES

Draft Resolution I

The **Working Group on Zooplankton Ecology** [Working Group on Zooplankton Ecology] (Chair: Dr L. Valdés, Spain) will meet in Aberdeen, Scotland, from 18–20 March 2002 to:

a) review results from Standards Sections and Stations from member countries, update them into the Summary status report on the zooplankton monitoring structure in the ICES area and analyse possible links with other data sets.
b) analyse what are the consequences of ocean climate changes for zooplankton processes and community structure.
c) search and evaluate possible biological indices of ecological significance for the fisheries and environmental assessment groups.
d) review and evaluate the electronic version of the ICES leaflets.
e) prepare activities for a second Workshop on zooplankton taxonomy in 2003.
f) consider and review plans for a workshop on modelling phytoplankton-zooplankton interactions in 2003.
g) review and evaluate the advances in the organisation of the ICES/PICES/GLOBEC Symposium.
h) future developments of Trans-Atlantic studies.

Supporting Information

Priority:	The activities of this group are a fundamental element of the Oceanography Committee, they are fundamental to understanding the relation between the physical, chemical environment and Living Marine Resources. Thus the work of this group must be considered of very high priority.
Scientific Justification:	a) This is a repeating task established by the Working Group to monitor the zooplankton abundance in the ICES area. The material presented under this item will be utilised to prepare the annual Summary status report on zooplankton in the ICES area. Reporting results must be supported by significant observations and trends based on time series sampling programmes. Links with other data sets (phytoplankton) will be considered. b) Time series studies on zooplankton long-term trends and their relationships with climate index (NAO, Gulf Stream north wall index) and global warming, suggest that important changes may occur in zooplankton processes and community structure as a result of climate change. Their consequences on the ecosystem structure will be analysed and discussed. c) Incorporating environmental information for the fisheries and environmental assessment

	groups is an important task that the group has initiated in 1999. The discussion on the selection, interpretation and validation of indices needs to be continued. The list of indices produced during 2001 needs to be reviewed and refined. d) The Working Group on Zooplankton Ecology recognises the opportunities that electronic media offers in terms of maximising distribution of information to the scientific community. The Working Group on Zooplankton Ecology has planned the edition of the ICES identification leaflets in a CD-ROM. The group will work inter-sessionally on such an initiative. During its annual meeting the group wants to review and evaluate the contents and quality of such CD-ROM. The ultimate objective is that ICES could offer this product to a larger community of scientist. e) The Working Group on Zooplankton Ecology is concerned about the decline of expertise in zooplankton taxonomy. A workshop was auspiced by the Working Group on Zooplankton Ecology in 2000 as a practical step towards strengthening taxonomic skills in the ICES area. Given the success of this workshop, the group felt that a further workshop should be considered to be held in two years. f) The difficulties in modelling the ecosystem functioning imposed by our limits to understand the phytoplankton-zooplankton interactions is recognised in recent literature. There is a need to communicate with modellers to review the advances in integrate ecosystem models. A modelling workshop auspiced by the Working Group on Phytoplankton Ecology and the Working Group on Zooplankton Ecology was proposed during the 2001 discussions. The Working Group on Zooplankton Ecology wants to be proactive in this practical initiative and prepare activities for this workshop programmed in 2003. g) The proposed ICES/PICES/GLOBEC Symposium will be a major event for the marine ecologist in general and planktologists in particular in 2003. The preparation of this event will be the responsibility of a Steering/Organising Committee, but the group as originator of this initiative wish to have up-dated information on the details and contribute when necessary to the good end of this stimulating challenge. h) GLOBEC is at its mid-life time and it is timely and valuable to evaluate further opportunities for practical Trans-Atlantic coordinated research. • In 2002 the present chairn will have covered his 3 year period and the group should elect a new member to take this position.
Relation to Strategic Plan:	This Working Group's activities embrace all elements of the scientific objective of understanding the physical, chemical, and biological functioning of marine ecosystems.
Resource Requirements:	The Working Groups programme encompass the ongoing work of all its members, hence there are no additional resource requirements beyond those required for the meeting.
Participants:	The group has a relatively small core membership, and needs to attract broader participation.
Secretariat Facilities:	None required
Financial:	None apart from the report's reproduction costs
Linkages to Advisory Committees:	The Group reports to Advisory Committee on the Marine Environment, mainly for the provision of scientific information on Ecosystems
Linkages to Other Committees or Groups	None
Linkages to Other Organisations:	PICES, GOOS and GLOBEC have many activities of very close interest to the activities of this group. Good contact is maintained. See for example Tors a, b, c, g and h

ANNEX 1 – LIST OF PARTICIPANTS

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ANNEX 2 – AGENDA AND PROGRAMME

FOR

Working Group On Zooplankton Ecology And Joint Meeting with Working Group On Phytoplankton Ecology Bergen, 26–29, March 2000

Monday 26 March (Institute Marine Research, Bergen)

Welcome, Agenda, Meeting Programme

09:15 – 12:30 **Update results from Standards Sections and Stations and consolidate inputs from member countries into the Summary status report on the zooplankton monitoring structure in the ICES area. [Tor a]** (Lead Role: Luis Valdés, Rapporteur: Chris Reid)

12:30 – 13:30 Lunch

13:30 – 17:00 **Continue with the discussion on results from Standards Sections and Stations.**

Discussion on the uses of biological indices and data produced in a routine basis for the fisheries and environmental assessment groups. **[Tor b]** (Lead Role: Doug Sameoto, Rapporteur: Webjorn Melle)

Tuesday 27 March

09:00 – 12:30 **Finalise the compilation of results, publications, and other material (video documentation of the work at sea, and images) from the June1993 Sea-going Workshop in Storfjorden**. **[Tor c]** (Lead Role: Peter Wiebe, Rapporteur: D. Sameoto)

Report and evaluate the results of the workshop on taxonomy of calanoids held in Terramare (Germany) in 2000. [Tor d] (Lead Role: L Valdés, Rapporteur: Steve Hay)

Review and evaluate the advances in the organization of the ICES/PICES/ GLOBEC Symposium. **[Tor e]** (Lead Role: Roger Harris, Rapporteur: L. Valdés)

12:30 –13:30 Lunch

13:30 – 17:00 **Prepare and formulate key questions requiring interdisciplinary dialogue for a possible joint meeting of the Oceanography Committee's Working Groups in 2002 (and/or theme sessions at ICES ASC). [Tor f]** (Lead Role: S. Hay, Rapp.: P. Wiebe)

Prepare for the meeting with Working Group on Phytoplankton Ecology.
Any other business. (Rapporteur: L Valdés)
Summary discussion, Drafting of report.

Wednesday 28 March

09:00 – 12:30	**Introduction to the WGPE-Working Group on Zooplankton Ecology joint meeting**
	Limits for modelling phytoplankton – zooplankton interaction. (Mills, WGPR) (P. Wiebe, Working Group on Zooplankton Ecology)
12:30–13:30	Lunch
13:30 –17:00	**How do characteristics of phytoplanktonic diet (size, morphology, physiological condition, toxicity) influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction? (Focussed to organism level when possible).** (Edler/Kuosa, WGPE) (R. Harris, Working Group on Zooplankton Ecology)
	Can a collapse in grazing pressure lead to symptoms of eutrophication?(Smayda/Bot, WGPE) (W. Melle, Working Group on Zooplankton Ecology)

Thursday 29 March

09:00 – 12:30	**Ways of improving the phytoplankton and zooplankton components in GOOS. (**Mills/Rey, WGPE) (C. Reid, Working Group on Zooplankton Ecology)
	Consider the scientific and operational merits of inclusion of, respectively, primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes. (Durselen/Bot, WGPE) (S. Hay, Working Group on Zooplankton Ecology)
12:30–13:30	Lunch
13:30 –17:00	**Consider the possibility of merging.** All
	Any other business.
	Summary discussion, Drafting of report.

Scientific justification

a) The Working Group on Zooplankton Ecology recognises the need for disseminating information in a timely and appropriate manner. The material presented under this item will be utilised to prepare the annual Summary status report on zooplankton in the ICES area. Reporting results must be supported by significant observations and trends based on time series sampling programmes.

b) Incorporating environmental information for the fisheries and environmental assessment groups is being demanding from different working groups and committees (e.g. ICES/GLOBEC Working Group on Cod and Climate Change, Working Group on Recruitment Processes and Advisory Committee on the Marine Environment). The group has initiated a discussion on the use of biological and environmental indices in 1999. The discussion on the selection, interpretation and validation of these indices need to be continued.

c) The work in bringing together all of the data collected during the June 1993 Workshop at sea in Storfjorden is nearly complete. The data are providing a foundation for several manuscripts. It is planned that a collection of papers describing the oceanographic conditions, and the results of the intercomparisons will be submitted before the next meeting.

d) This workshop was auspiced by the Working Group on Zooplankton Ecology and is a practical step towards strengthening taxonomic skills in the ICES area. Presumably, the material to be presented in the Workshop (e.g., check lists of pelagic copepods) will be of a great value for the Working Group on Zooplankton Ecology.

e) The proposed ICES/PICES/GLOBEC Symposium will be a major event for the marine ecologist in general and planktologists in particular in 2003. The preparation of this event will be responsibility of a Steering/Organising Committee, but the group as originator of this initiative wish to have up-dated information on the details and contribute when necessary to the good end of this stimulating challenge.

f) The group recognised that the joint meeting of the Oceanography Committee's Working Groups in 2002 is an opportunity to discuss topics of common interest. The production of a stimulating agenda is an interactive process among the different working groups. The group has identified three key questions and wish to hear the topics proposed by the other working groups to consider and/or formulate additional key questions requiring interdisciplinary dialogue.

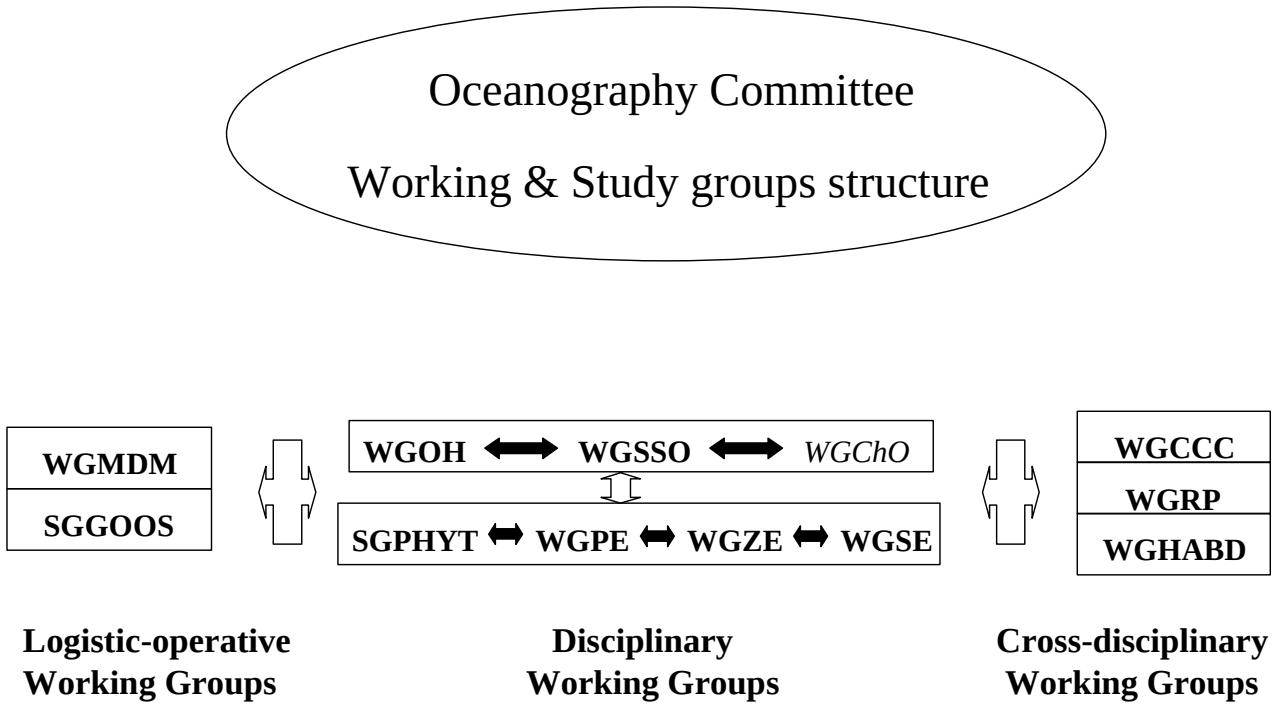
g) The joint meeting between Working Group on Phytoplankton Ecology and Working Group on Zooplankton Ecology is very welcome and timely. Many of the issues which the Working Group on Zooplankton Ecology is dealing with will benefit from a wider, collaborative approach. The development of working links between both groups has been mentioned frequently in the past and this is an excellent opportunity to tackle a well defined agenda of common interests.

ANNEX 3 – EVOLUTION OF THE ICES WORKING GROUP ON ZOOPLANKTON ECOLOGY BY THEIR TERMS OF REFERENCE

WORKING GROUP ON ZOOPLANKTON ECOLOGY TORS	1992	1993	1994	1995	1996	1997	1998	1999	2000	PRODUCTS
Methods for biomass & production	xxxxx	xxxxx	↓							Zooplankton Methodological Manual (see www)* (and establishment of web site)
Standardization. & Method. manual	xxxxx	xxxxx	xxxxx	xxxxx	(xxxx)	(xxxx)	xxxxx	xxxxx	xxxxx	
Progress on new technologies	xxxxx	xxxxx	xxxxx		xxxxx		xxxxx		xxxxx	
Laboratory and Sea-going WS	xxxxx	xxxxx	↓							Sea-going WS, papers on intercalibration (compilation of data in 4 CDs)
Results of Laboratory and Sea-going WS			xxxxx	xxxxx			xxxxx	xxxxx	xxxxx	
Plans for WS on Calanus			xxxxx		xxxxx					
Trans Atlantic Studies on Calanus				xxxxx						
Trans Latitudinal Studies on Calanus				xxxxx						
ICES GLOBEC				xxxxx		xxxxx	xxxxx	xxxxx		
EU-ENRICH (TASC-GLOBEC)									xxxxx	
Comp. Zoo Ecology North Atlantic North Pacific									xxxxx	
ICES/PICES/GLOBEC Symposium									xxxxx	2003 International Symposium on Zooplankton Ecology
Zoo grazing and HABD					xxxxx					
Phytoplankton-Zooplankton interactions									xxxxx	
Interactions zoo populations/fish stocks					xxxxx					
Zoo monitoring, exchange information					xxxxx	xxxxx	xxxxx	xxxxx xxxxx		Recompilation of monitoring programmes in ICES area
Zoo monitoring and GOOS										
CPR surveys and on-going monitoring						xxxxx	xxxxx			
Environmental Status report, data products					xxxxx				xxxxx	Zooplankton Monitoring Status Report
Environmental indices for assess. groups								xxxxx	xxxxx	
Taxonomic code systems for use in ICES						xxxxx				
Zoo taxonomic skills within ICES							xxxxx	xxxxx	xxxxx	WS on Zooplankton taxonomy (June, 2000)
ICES Five-Year Plan							xxxxx	xxxxx		
Preparation key questions, Working Groups meeting 2002									xxxxx	
Restructuring the Working Group on Zooplankton Ecology?									xxxxx	

("The Role of Zooplankton in Global Ecosystem Dynamics: Comparative studies from World Oceans")

ANNEX 4 – STRUCTURE OF THE OCEANOGRAPHY COMMITTEE AS IT IS SEEN BY THE WORKING GROUP ON ZOOPLANKTON ECOLOGY



ANNEX 5 – ZOOPLANKTON MONITORING RESULTS IN THE ICES AREA, SUMMARY STATUS REPORT 1999/2000

Prepared by the ICES Working Group on Zooplankton Ecology

Editor: Luis Valdés

Data provided by: Doug Sameoto, Astthor Gislason, Sonia Batten, Ellertsen Bjørnar, Steve Hay, Lutz Postel, Roger Harris, Xabier Irigoen, Luis Valdés and M. Teresa Alvarez-Ossorio

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Contents:

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1. Background

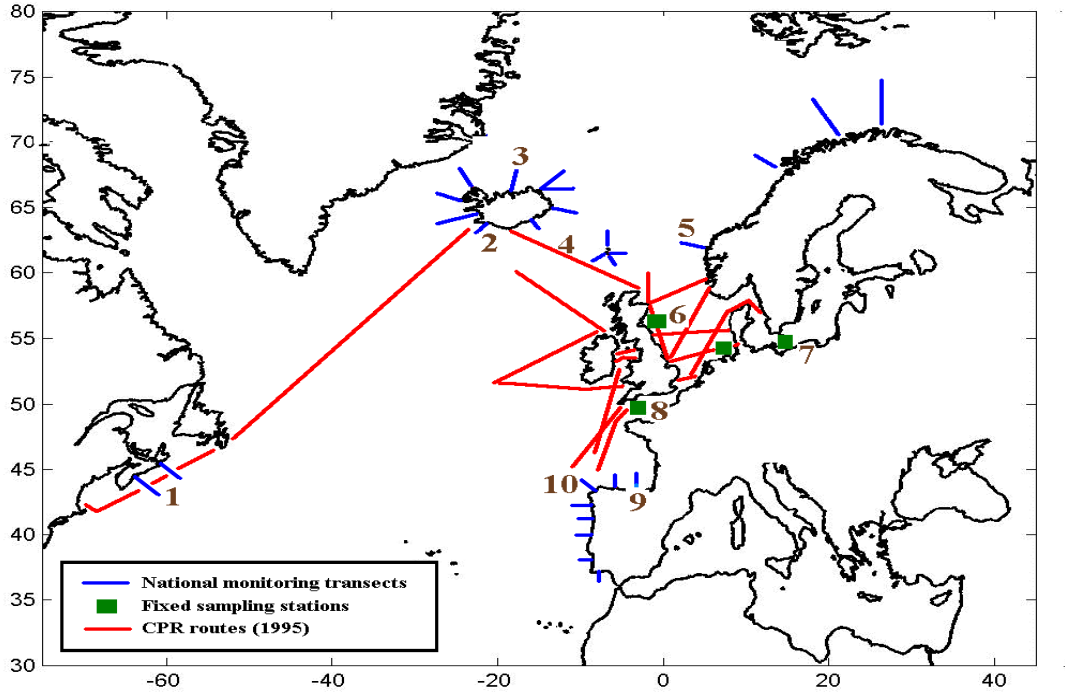
The ICES strategic plan recognised the ICES role in making scientific information accessible to the public in addition to the fisheries and environmental assessment groups. Thus, during the 1999 Annual Science Conference a general request was made from ICES to the Oceanography Committee Working Groups to develop data products and summaries that could be provided on a routine basis to the ICES community via the ICES web site. The Working Group on Zooplankton Ecology (Working Group on Zooplankton Ecology) consider as a priority action to produce a summary report on zooplankton activities in the ICES area based on the time series obtained in the national monitoring programmes.

The purpose of producing such a report is to give a global (ICES scale) and visual overview of zooplankton distributions for the preceding years (in the form of time series) with a brief interpretation of the ecological significance of these results. Reported results are supported by significant observations and trends based on time series sampling programmes from ongoing monitoring sites in the ICES region. Most of the graphs and data from different regions are presented here in the same format and data units were expressed as dry weight or in numbers per m^2; so comparisons between regions can easily be made.

Temperature can have a large influence on the community structure and production of zooplankton and can cause large seasonal, yearly and decadal changes in zooplankton population size. It was for this reason that data sets are presented here by affinities in temperature and biogeographical areas.

2. Regional coverage

The information collated by the ICES Working Group on Zooplankton Ecology, zooplankton sampling programmes in the ICES area include 4 fixed stations and 27 standard sections (approx. 200 sampling stations) distributed on the continental margins of both America and Europe and covering from the temperate latitudes of South of Portugal to the boreal regions of North of Norway. In addition to this, there are several fixed CPR routes that cover coastal and oceanic waters in the Atlantic. The sampling networks and the collections used in this report are shown in Figure 1.



oup

Zooplankton is monitored with a variety of nets, time frequency and spatial coverage, thus for a comprehensive interpretation of the data sets some information on metadata to describe the content, quality, and other characteristics of

data (sampling gear, mesh size, depth, sampling site, dates, responsible for the data, etc.) are included in Section 4. These metadata will help a person to locate and understand the data presented in this document.

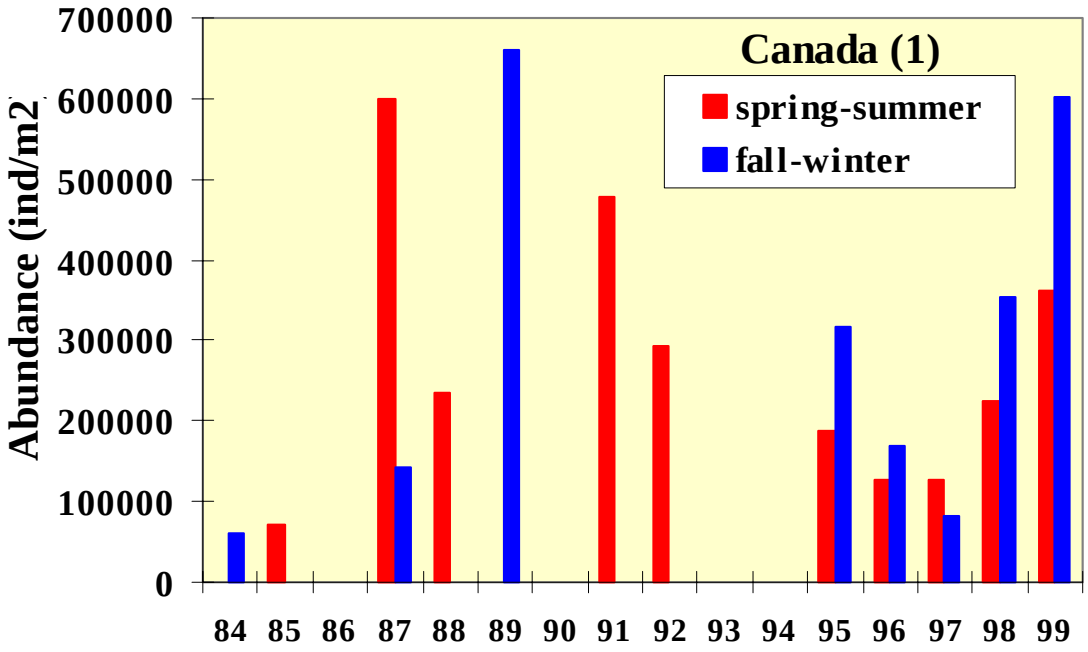
3. Regional descriptions

Area 1: Emerald Basin (West Atlantic, Scotian Shelf)

Zooplankton are sampled twice a year (spring-summer, fall) with a variety of nets and optical instruments on the Halifax (Emerald Basin) and Louisbourg transects over the Scotian Shelf. These data are used to monitor long-term changes in the levels of zooplankton species. A stock status report on the state of the phytoplankton and zooplankton in Canadian Atlantic waters is prepared each year (e.g., Sameoto, 1999). This report is also published in the web at http://www.dfo-mpo.gc.ca/csas.

It is believed that the size of the autumn population of *Calanus finmarchicus* in Emerald Basin is a good indicator of the size of the population on the Scotian Shelf during the previous spring and summer (Sameoto and Herman, 1990). The *C. finmarchicus* population declined between 1995 and 1997 to reach the historical low levels of 1984. During 1998 and 1999 the population had recovered reaching maximum levels in autumn of 1999. *C. finmarchicus* accounts for a significant portion of total zooplankton, which shows the same general pattern in abundance (Figure 2). The temperature anomaly at 50 m in June and the numbers of *C. finmarchicus* appeared to be related, showing that, as the temperature increased, there was generally an increase in the size of the *C. finmarchicus* population.

Figure. 2: Abundance of zooplankton in Emerald Basin (1984–1999).



References

Sameoto, D. D. 1999. DFO Science Stock report G3–02 (1998). Maritimes Regional Advisory Process Depart. of Fisheries and Oceans, P.O. Box 1006, Dartmouth, N.S., Canada B2Y 4A2.

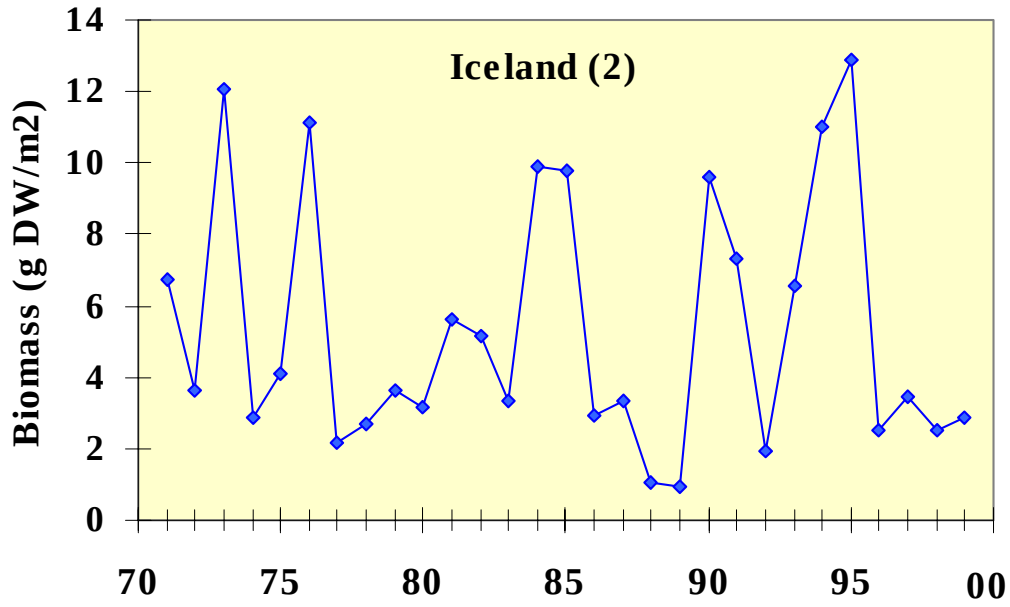
Sameoto, D. D., and Herman, A.W. 1990. Life cycle and distribution of *Calanus finmarchicus* in deep basins on the Nova Scotia shelf and seasonal changes in *Calanus spp*. Marine Ecology Progress Series, 66: 225–237.

Area 2 and 3: Selvogsbanki (South Iceland) and Siglunes (North Iceland)

The Icelandic monitoring programme on zooplankton consists of a series of perpendicular transects from the coastline into the open sea. Sampling at the section lines to the north and east of Iceland was started in the 1960s. Additional section lines to the south and west were added in the 1970s. There are now about 90 stations in total. Zooplankton investigations are carried out at these stations every year in May-June. Long term changes in zooplankton biomass at Selvogsbanki transect from the south of Iceland and at Siglunes from the north are shown in Figure 3 and 4. At Selvogsbanki the values represent averages from 5 stations, while at Siglunes the values are averages from 8 stations.

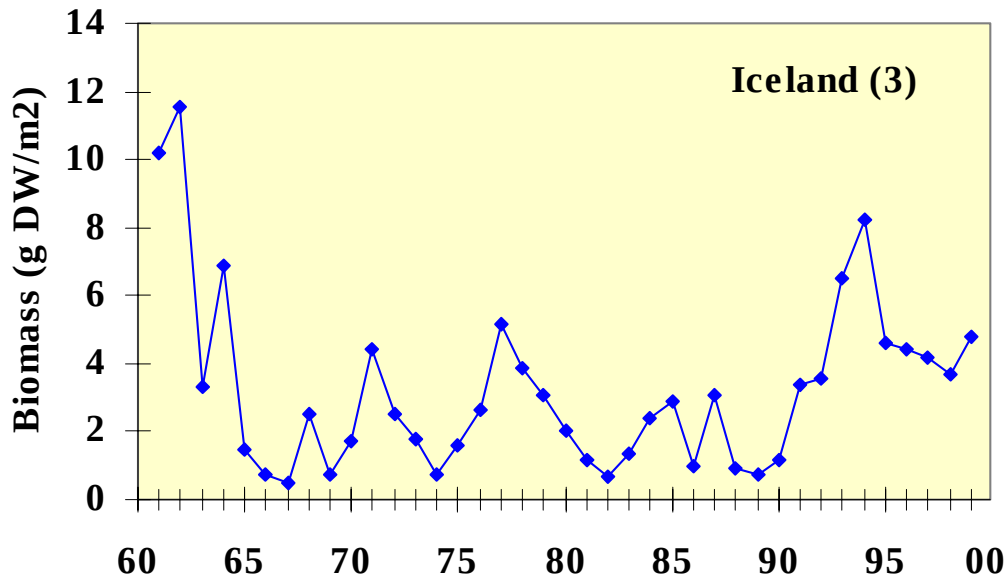
At Selvogsbanki transect the zooplankton biomass showed a peak during the early 80's while a low was observed during the late 80's. A peak was also observed around 1995 but since then zooplankton biomass at Selvogsbanki transect has been decreasing. The time period between the zooplankton peaks at Selvogsbanki transect has been around 10 years.

Figure 3: Annual values of zooplankton biomass at Selvogsbanki transect since 1970.



North of Iceland (Siglunes transect) the high values of zooplankton in the beginning of the series dropped drastically with the onset of the Great Salinity Anomaly of the 1960s. Since then zooplankton biomass has varied with highs at approximately 7–10 years intervals. The highest and lowest values differ by a factor of about 24. The last peak in zooplankton biomass occurred around 1994, since then the biomass has been declining.

Figure 4: Annual values of zooplankton biomass at Siglunes transect since 1960.



With the exception of 1977 a more or less synchronous variability has been observed in the Sub-Arctic waters to the north of Iceland and in the Atlantic water to the south of the country. Inter-annual changes of the observed zooplankton biomass at Iceland may in part be explained by variable hydrographic conditions and timing of the phytoplankton spring bloom, comparison to other data from the northern North Atlantic shows that observed zooplankton biomass in spring is descriptive of the mean copepod biomass in that year. Recent research also shows that the variation of zooplankton biomass in the Icelandic area is in tune with long term variability of zooplankton abundance over a much larger area, i.e., in the northern North Atlantic in general (Astthorsson and Gislason, 1995).

References

Astthorson, O. S., and Gislason, A. 1995. Long term changes in zooplankton biomass in Icelandic waters in spring. ICES Journal of Marine Science, 52:657–668.

Area 4: Iceland-Scotland line

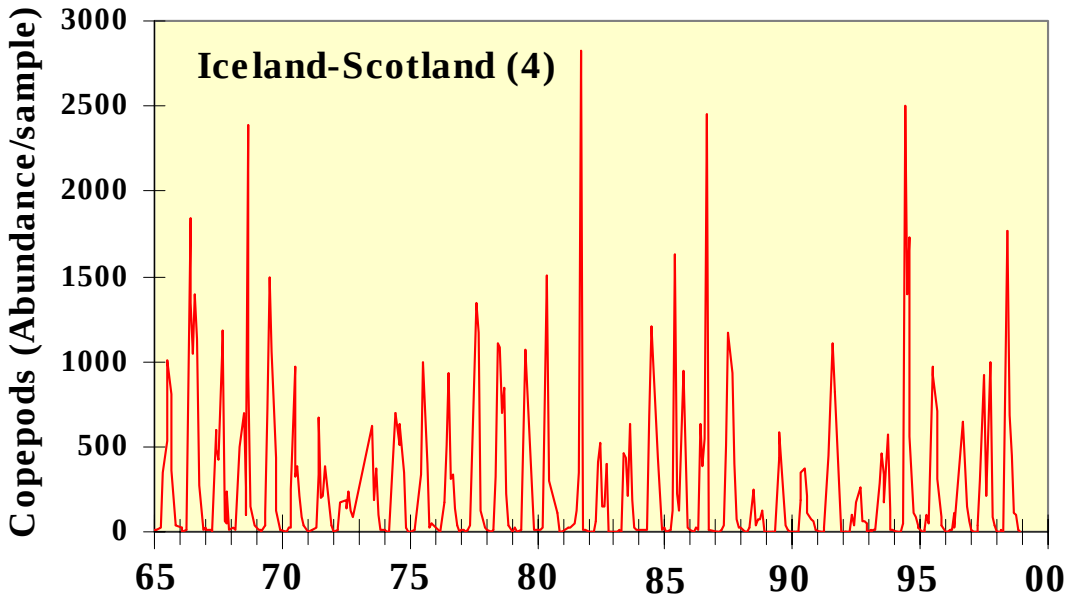
The Continuous Plankton Recorder (CPR) is deployed monthly on approximately 20–25 standard routes across the North Sea and North Atlantic (Figure 1). During 1998, a total of 4105 samples were collected and analysed on these routes, representing 82,609 sampled nautical miles and a increase of 3.5% on the sampling during 1997. Routine instrumentation of CPRs is expanding. Many are now deployed with a simple temperature sensor and some carry a more sophisticated instrument package that measures salinity, temperature and fluorescence. These data are invaluable in providing supplementary information on the physical environment of the plankton. Several CPRs are also fitted with electromagnetic flowmetres to quantify the volume of water filtered per sample. The undulating replacement vehicle for the CPR, the U-Tow, is also undergoing continuing development. Sea trials have progressed well, with the device currently capable of undulating to depths of 60 m at speeds of about 15 knots.

Unusually high numbers of oceanic species were recorded in the North Sea during 1997 and 1998, including some previously unrecorded species in this area, which suggests an unusually high inflow of oceanic water (Edwards *et al*., in press), probably linked to meteorological anomalies. This influx contributed to an increasing trend in biodiversity of North Sea plankton, as measured by the CPR, seen over the last decade. An increase in the contribution of the meroplankton to the plankton community of the North Sea has also been noted.

The series shown in Figure 5 is for total copepods along a route between the north of Scotland and Iceland. The small copepods *Acartia clausi* and *Oithona* spp. are dominant in this area, in terms of numbers and biomass. Fluctuations in their abundance are probably responsible for much of the considerable interannual variation shown below. *Calanus finmarchicus* is a dominant large species in this area and its recent decline (documented by Planque and Reid, 1998) has

probably contributed to the generally lower abundances seen in the total copepod community in the late 1980s/1990s. Climatic indices have been shown to significantly correlate with this abundance although the mechanism is still not known. The figure demonstrates that although significant declines may be witnessed in one key species, owing to varying life history strategies and behavioural responses of different species the overall abundance of the copepod community might not display the same trend.

Figure 5: Copepod abundance in the CPR route Iceland-Scotland.



References

Edwards, M., John, A. W. G., Hunt, H. G., and Lindley, J. A. 1999. Exceptional influx of oceanic species into the North sea in late 1997. Journal of the Marine Biological Association of the United Kingdom. 79: 737–739.

Planque, B., and Reid, P. C. 1998. Predicting *Calanus finmarchicus* abundance from a climatic signal. Journal of the Marine Biological Association of the United Kingdom. 78, 1–4.

Area 5: Svinøy (Norwegian Sea)

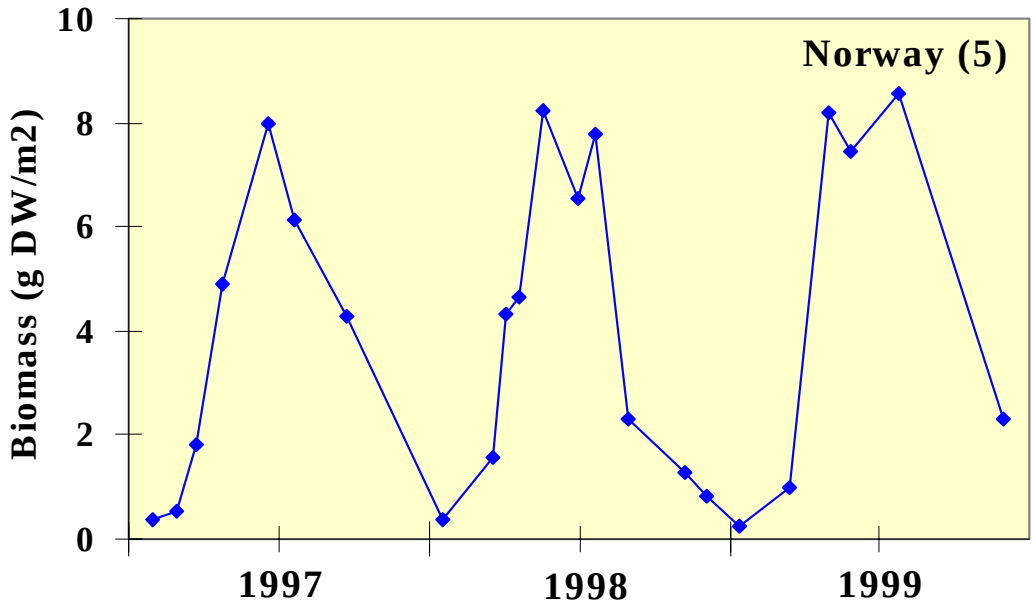
Four fixed transects are sampled within the "IMR Monitoring Programme": 2 transects into the Norwegian Sea [the Svinøy transect (15 stations) and the Gimsøy transect (10 stations)] and 2 transects in the Barents Sea [the Fugløya-Bjørnøya transect (7 stations) and the Vardø-North transect (8 stations)]. The transects are sampled at various frequencies, the Norwegian Sea transects 6–10 times/yr and the Barents Sea transects 3–5 times/yr. Additionally the Norwegian Sea is surveyed in May and July-August, both surveys ca. 50–100 stations. The data are stored at the HELIX database at IMR Periodic reports are made annually to the Ministry of Fisheries and to the IMR´s "Havets Miljø" (Annual Report on Marine Environment).

The development of zooplankton biomass in spring at the Svinøy transect showed very small variations among years in the period 1997–99, and the maximum biomass in early summer varied between 8 to 9.3 gDW/m^2 (Figure 6). In the western part of the transect, in areas more influenced by the Atlantic inflow and also affected by the East Icelandic Current the seasonal cycle in zooplankton biomass in 1999 showed some differences from the one observed in previous

two years. In 1997 and 1998 the biomass maxima was observed in mid May and mid June, respectively, in 1999 the maximum was observed in late July.

The high biomass in the western part of the Svinøy transect in summer 1999 is consistent with observations in large parts of the Norwegian Sea, where the average zooplankton biomass (above 8 gDW/m^2) was considerably higher than the previous year (1998, approx. 5 gDW/m^2).

Figure 6: Zooplankton biomass at Svinøy transect (Norwegian Sea).

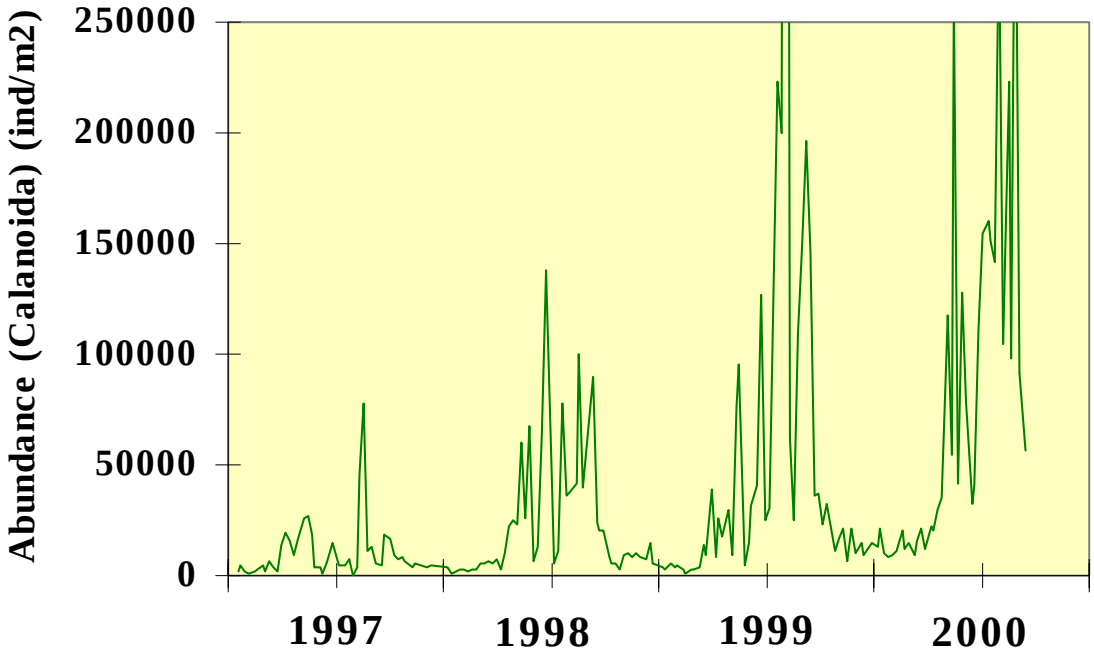


Area 6: Stonehaven (Scotland, North Sea)

Since 1997 a site located some three miles offshore of Stonehaven (South Aberdeen, 56º 57.8' N 2º 6.2' W) in North Sea water 50m deep, has been sampled at weekly intervals. The primary objective of the programme is to establish a monitoring base for assessing the status of the Scottish coastal water ecosystem, and the responses to climate change. This involves extensive physical, chemical and biological sampling, with special attention to the analysis of hydrographical parameters, nutrients, chlorophyll *a*, and phytoplankton and zooplankton species. Comparison of the results with archive regional data on temperature, salinity and nutrients and phytoplankton biomass, indicates that the site off Stonehaven provides a reasonable state index of the coastal waters. Data are regularly processes in the FRS MLA database and some of these data are displayed on the MLA web site (http://www.marlab.ac.uk/Montoring/Stonehaven/Stoneframe.html) and published in periodic reports (e.g., Heath *et al*., 1999).

The biological data document the seasonal succession of plankton species and their abundances. Mesozooplankton shows considerable differences in abundance between years (Figure 7). Since 1997 the ecosystem has supported higher stocks of plankton, and probably higher production. Particular species have indicated different responses and some of these can be related to oceanographic events, for example the annually variable influx of high salinity oceanic water in autumn. The annual cycles also indicate important variation in overwinter conditions and ensuing spring survival and production for some species.

Figure 7: Weekly abundance of copepods (Calanoida) during 1997–1999 at Stonehaven sampling site (North Sea).



References

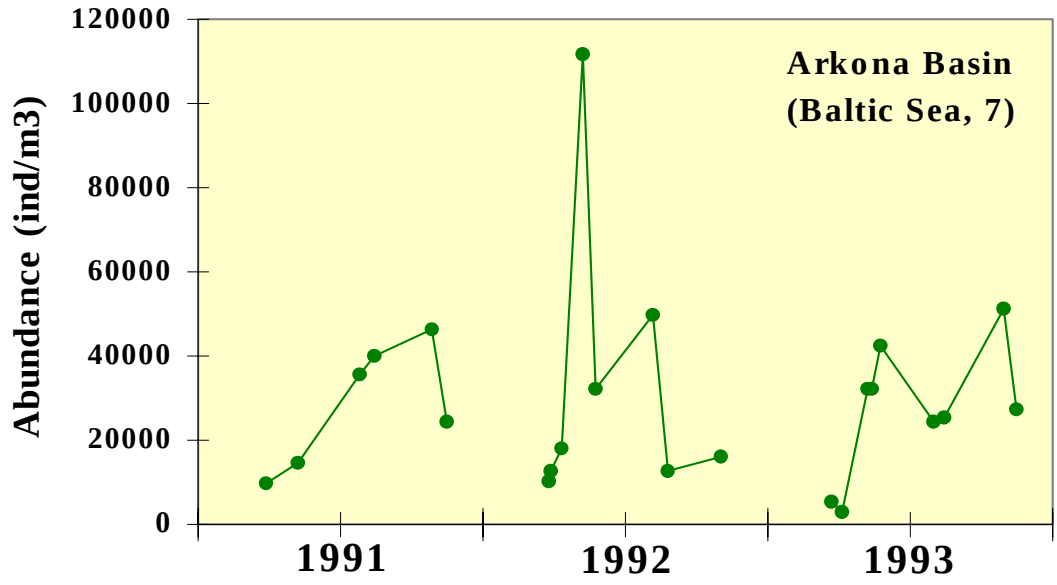
Keith, M. R., Adams R. D., Brown, F., Fraser, S., Hay, S. J., Kelly, M. C.,Macdonald, E. M., Roberston, M. R., Robinson, S., and Wilson, C. 1999. Plankton monitoring off the east coast of Scotland in 1997 and 1998. Fisheries Research Services Report, No 13/99, 32pp.

Area 7: Arkona Basin (Germany, Baltic Sea)

The Baltic Sea Monitoring Programme (BMP) consists of 24 international stations. The stations cover the different sub-areas of the Baltic Sea from the south-westerly Mecklenburg Bay to the north-easterly Gulf of Finland. Each station is sampled at least 4 times a year, but laboratories of all Baltic States contribute to the BMP increasing the amount and the frequency of data. Data are stored at HELCOM (Helsinki Commission) and will be stored at ICES in the future. Periodic Assessment Reports are prepared every 5 years by contributions of all HELCOM member states (http//www.helcom.fi; HELCOM, 1996). Currently, the 4th report is under preparation.

For purposes of illustration one station (54°55`N, 13°30'E) has been chosen from the DOD (IOW) data base (Figure 8). This station is sampled from the surface down to 25 m or to the depth of the seasonal thermocline (30 m). A 3 year period (1991–1993) is shown, but the total series covers the period 1973 up to now. Variations in the range 10000–50000 ind/m^3 are typically observed during the seasonal cycle in the western Baltic Sea. The peak of plankton observed in spring 1992 was originated by a mass development of rotifers, which often happened after mild winters. In spite of this peak, the cladoceran *Bosmina coregonii* is the dominant species during summer when water temperature reaches 16 ºC (HELCOM, 1996).

Figure. 8: Zooplankton abundance at Arkona Basin (Baltic Sea) in 1991–1993.



References

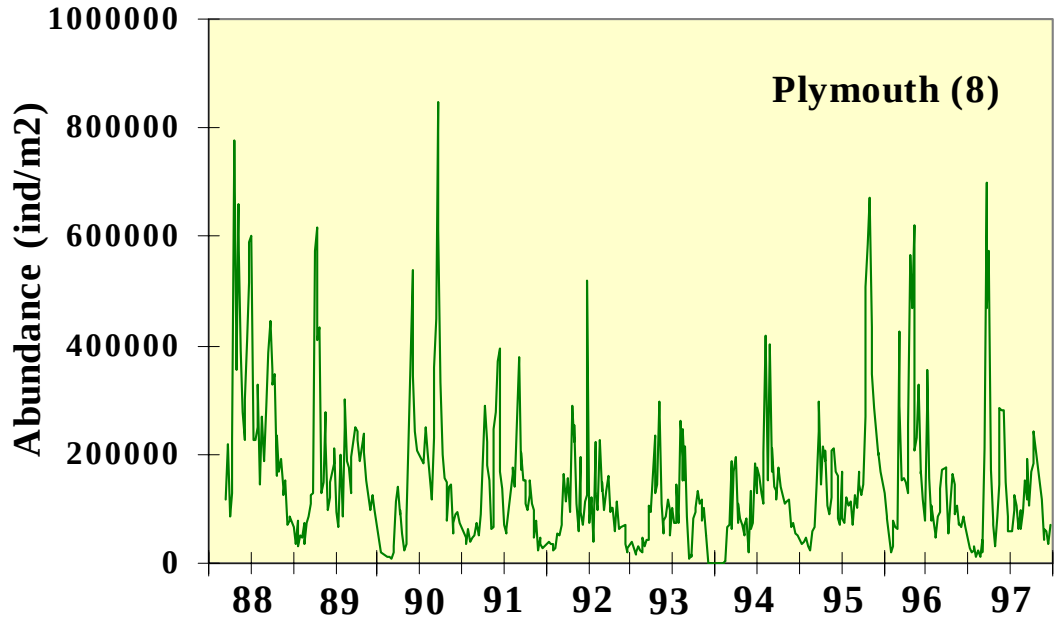
HELCOM. 1996. Third Periodic Assessment of the state of the Marine Environment of the Baltic Sea, 1989–1993. Baltic Sea Environment Proceedings 64B, 252 pp. [available at: Akateeminen Kirjakauppa, Pl 128, FIN-00101 Helsinki, Finland]

Area 8: Plymouth (South England, Celtic Shelf)

Zooplankton monitoring data are collected at a station (L4) situated about 15 miles SW of Plymouth in the English Channel. This station is about 50 m deep and is influenced by seasonally stratified and transitional mixed-stratified waters (Pingree and Griffiths, 1978). Duplicate zooplankton samples are collected weekly with a 200 µm WP2 net towed vertically from 50 m to the surface. Animals are counted and identified to genera or species level under dissecting microscope. L4 zooplankton data are complemented with other environmental parameters such as temperature and phytoplankton. L4 data are maintained at the Plymouth Marine Laboratory and will be soon made publicly available through a programme funded by the NERC thematic research programme Marine Productivity. L4 has also been used for a number of seasonal studies into population dynamics, reproduction and feeding (Green *et al*., 1993, Pond *et al*., 1996, Irigoien *et al*. 2000a, b) in order to have a better understanding of the mechanisms underlying the changes in the long term trends.

Zooplankton (Figure 9) and copepod abundance at L4 shows a decreasing trend from 1988 to 1995 caused mainly by the decrease of the spring developing species *Pseudocalanus* sp. and *Acartia* sp. During the last years analysed the abundance shows some recovery mainly due to two autumn developing small species, *Euterpina* sp. and *Oncaea* sp, and possibly related to the increase in river runoff. This implies that the changes are not only in abundance but also in the composition of the population, shifting to smaller copepods with possible consequences for fish larvae dependent on larger copepods for their diet.

Figure 9: Weekly zooplankton abundance at Station L4 (Plymouth, Celtic Shelf).



At present, the series is still not long enough to determine whether the trends identified are part of long term cycles such as the one described by Russell *et al.* (1971) for station E1 off Plymouth or the ones related to the position of the Gulf Stream (Taylor, 1995) or to the North Atlantic Oscillation (NAO) (Fromentin and Planque, 1996). Nevertheless, the trends found in this series for copepods agree with those found by Greve *et al*. (1996) in the German Bight or by Broekhuizen and Macenzie (1995) in different areas of the North Sea, suggesting a general pattern for the area.

References

Broekhuizen, N., and McKenzie, E. 1995. Patterns of abundance for *Calanus* and smaller copepods in the North Sea: time series decomposition of two CPR data sets. Marine Ecology Progress Series, 118: 103–120.

Fromentin, J. M., and Planque, B. 1996. *Calanus* and environment in the eastern North Atlantic. II. Influence of the North Atlantic Oscillation on *C. finmarchicus and C. helgolandicus.* Marine Ecology Progress Series, 134: 111–118.

Green, E. P., Harris, R. P., and Duncan, A., 1993. The seasonal abundance of the copepodite stages of *Calanus helgolandicus* and *Pseudocalanus elongatus* off Plymouth. Journal of the Marine Biological association of the United Kingdom., 73: 109–122.

Greve, W., Reiners, F., and Nast, J. 1996. Biocoenotic changes of the zooplankton in the German Bight: the possible effects of eutrophication and climate. ICES Journal of Marine Science, 53: 951–956.

Irigoien X., Head, R. N., Harris, R. P., Cummings, D., Harbour, D., and Meyer-Harms, B. 2000a. Feeding selectivity and egg production of *Calanus helgolandicus* in the English Channel. Limnology and Oceanography, 45: 44–54.

Irigoien, X., Harris, R. P., Head, R. N., and Harbour, D. 2000b. The influence of diatom abundance on the egg production rate of *Calanus helgolandicus* in the English channel. Limnology and Oceanography, 45: 1433 – 1439.

Pingree, R. D., and Griffiths, D.K. 1978. Tidal fronts on the shelf seas around the British isles. Journal of Geophysical Research, 83: 4615–4622.

Pond, D., Harris R. P., Head, R. N., and Harbour, D. 1996. Environmental and nutritional factors determining seasonal variability in the fecundity and egg viability *of Calanus helgolandicus* in coastal waters off Plymouth, UK. Marine Ecology Progress Series, 143: 45–63.

Russell, F. S., Southward, A. J., Boalch, G. T., and Butler, E. I. 1971. Changes in biological conditions in the English Channel off Plymouth during the last half century. Nature 234: 468–470.

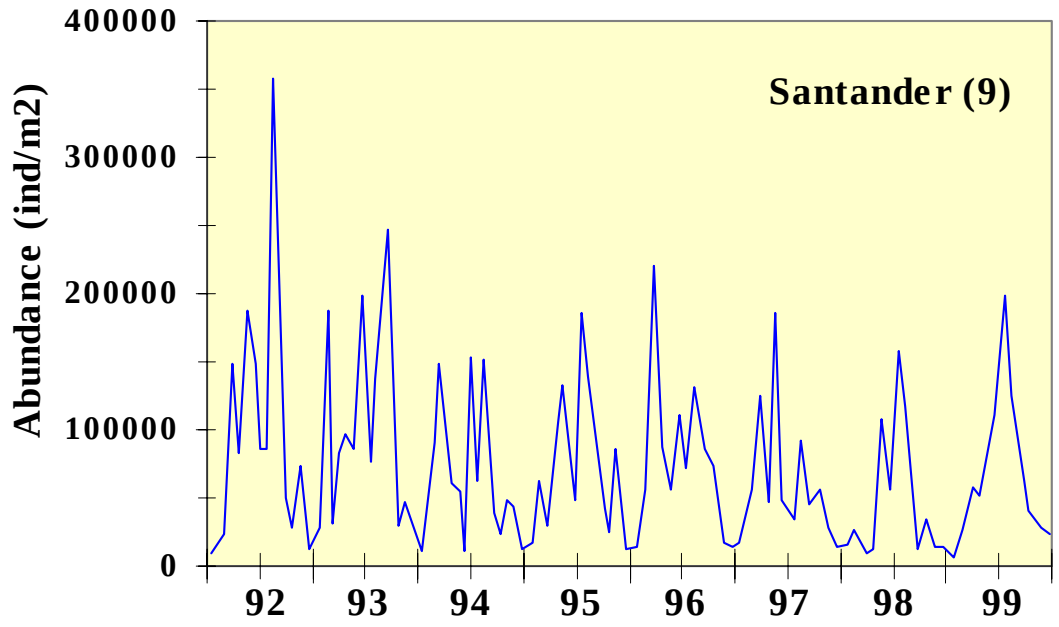
Taylor, A. H., 1995. North –South shifts of the Gulf stream and their climatic connection with the abundance of zooplankton in the U.K. and its surrounding seas. ICES Journal of Marine Science, 52: 711–721.

Area 9: Santander (Southern Bay of Biscay)

Four transects are monitored in the ICES area off the Spanish coast. This involves an extensive physical, chemical and biological monthly sampling series at each site, with special attention to the sampling and analysis of hydrographical parameters, nutrients, chlorophyll *a*, and phytoplankton and zooplankton species. Data are regularly processes in the IEO databases and hydrographic and nutrients data are also available in the ICES database. Depending on the transect, the time series extend from 1988 (A Coruña and Vigo), 1991 (Santander) and 1994 (Asturias).

Long term changes of zooplankton abundance at Santander shows a slight decreasing trend up to 1998 (Figure 10). The result is in opposition to the upward trend showed by the water column stratification index (Lavin *et al.*, 1998). This relationship between zooplankton and environmental conditions stress the importance that lengthening of the time during which the water column remains stratified could have in limiting the interchange of nutrients from deeper to surface waters and consequently limiting the growth of phytoplankton and zooplankton (Valdés and Moral, 1998). A similar relationship between an increasing trend in the water column stratification and a decline of zooplankton biomass was reported by Roemmich and McGowan (1995) at the Californian coast (CalCOFI series).

Figure 10: Monthly values of zooplankton abundance off Santander.



References

Lavín, A., Valdés, L., Gil, J., and Moral, M. 1998. Seasonal and interannual variability in properties of surface water off Santander (Bay of Biscay) (1991–1995). Oceanologica Acta, 21 (2): 179–190.

Roemmich D., and McGowan, J. 1995. Climatic warming and the decline of zooplankton in the California current. Science, 267: 1324–1326.

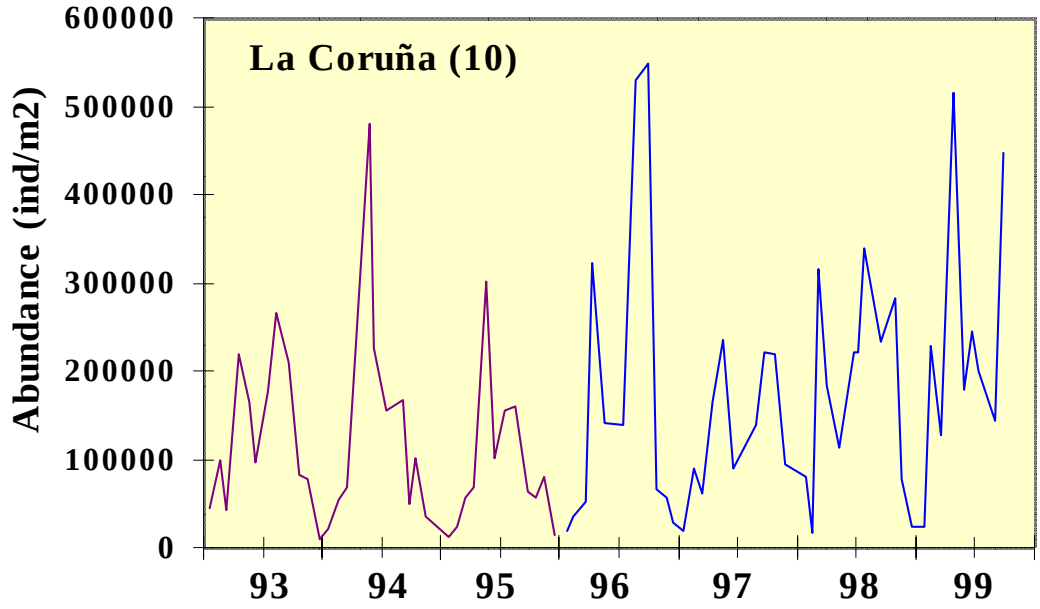
Valdés, L., and Moral, M. 1998. Time series analysis of copepod diversity and species richness in the southern Bay of Biscay (Santander, Spain) and their relationships with environmental conditions. ICES Journal of Marine Science, 55: 783–792.

Area 10: A Coruña (NW Iberian Peninsula)

In the coastal and neritic regions off Galicia (NW Spain) the classical pattern of seasonal stratification of the water column in temperate regions is masked by upwelling events that occurs yearly from May to September. These upwelling events let zooplankton populations to find conditions favourable to its development in the summer months, the opposite of what occurs in other temperate seas in this season of the year. Nevertheless, upwelling are highly variable in intensity and frequency and they show a significant variability from year to year.

Zooplankton values in A Coruña (Figure 11) differs to that shown in Santander (Figure 10): zooplankton abundance is higher in A Coruña and the time series of zooplankton abundance do not show any trend. Both characteristics are partly due to the influence of the seasonal upwelling which prevent the water column of a strong stratification, reinforce the input of nutrients to the photic layer, enhance the growth of phytoplankton populations and therefore enhance the growth of zooplankton populations. [Note that the time series showed in the Figure 11 is composed by two curves, the first one stands for the zooplankton >250 µm, whereas the second curve stands for zooplankton >200 µm].

Figure 11: Monthly zooplankton abundance off A Coruña. (purple line= 250 µm mesh size; blue line = 200 µm mesh size).



4. Characteristics of the collections used (Table of Metadata)

	CANADA (1)	ICELAND (2)	ICELAND (3)	ICELAND-SCOTLAND (4)
Monitoring programme	Scotian Shelf	MRI-Iceland	MRI-Iceland	Continuous Plankton Recorder
Sampling location	Emerald Basin	Selvogsbanki-transect	Siglunes-transect	Iceland - N Scotland Transect
Latitude (N)	43º 57' N	*	*	62º 30' N to 58º 50' N
Longitude (E-W)	62º 57' W	*	*	18º W to 4º 30' W
Station Depth (m)	265	*	*	*
Period of data available	1984–1999	1971-present	1961-present	1946-present
Frequency (number of cruises/yr)	random	Yearly (1 May-June)	Yearly (1 May-June)	approx 12, some missing mon/yrs
Gear/diam (cm)	ring/ 75	1971–91: Hensen; 92-pres: WP-2	1971–91: Hensen; 92-pres: WP-2	CPR, aperture 1.24 cm x 1.24 cm
Mesh (um)	250	200	200	280
Depth of sampling (m)	0–265	0–50	0–50	7–10
Contact person	Doug Sameoto	Astthor Gislason	Astthor Gislason	Chris Reid
Email address	sameotod@mar.dfo-mpo.gc.ca	astthor@hafro.is	astthor@hafro.is	pcre@wpo.nerc.ac.uk
Location of data	bio/chem database BIO	database MRI	database MRI	SAHFOS database
Observations (*)		Transect of 5 stns from 63°41'N, 20°41'W (bottom depth: 46m) - 63°00'N, 21°28'W (bottom depth: 1004m)	Transect of 8 stns from 66°16'N, 18°50'W (bottom depth: 80m) - 68°00'N, 18°50'W (bottom depth: 1045m)	Approx 22 individual samples per transect are averaged

	NORWAY (5)	ABERDEEN (6)	ARKONA BASIN (7)
Monitoring programme	IMR-Bergen	FRS-MLA	IOW, Germany
Sampling location	Svinøy transect Norway	Stonehaven	Arkona Basin, Baltic Sea
Latitude (N)	*	56° 57.80' N	54º 55'W
Longitude (E-W)	*	02° 06.80' W	13º 30'E
Station Depth (m)	*	50	48
Period of data available	1993 -present	1997 - present	1973-present
Frequency (number of cruises/yr)	6–10	Weekly (52)	Seasonally (4)
Gear/diam (cm)	WP-2 (56)	Bongo /40	WP-2
Mesh (um)	200	200	100
Depth of sampling (m)	0–150	47	
Contact person	Bj. Ellertsen	Steve Hay	Lutz Postel
Email address	bjornar.ellertsen@iMrno	haysj@marlab.ac.uk	lutz.postel@io-warnemuende.de
Location of data	Helix database, IMR	SERAD, FRS MLA	German Ocean Data Centre, IOW
Observations (*)	Transect of 15 stns from 62°22'N, 5°12'E (bottom depth: 160m) - 64°40'N, 0°00'W (bottom depth: 2695m)		
	PLYMOUTH (8)	SANTANDER (9)	LA CORUÑA (10)
Monitoring programme	L4-PML/UK	IEO-SPAIN	IEO-SPAIN
Sampling location	Plymouth	Santander	La Coruña
Latitude (N)	50° 15' N	43° 34.4' N	43° 25.3' N
Longitude (E-W)	4° 13' W	3° 47.0' W	8° 26.2' W
Station Depth (m)	50	110	77
Period of data available	1988 - 1997*	1991-present	1990-present
Frequency (number of cruises/yr)	Weekly (~40)	Monthly (12)	Monthly (12)
Gear/diam (cm)	WP2	Juday 50	Juday 50
Mesh (um)	200	250	1971–96: 250; 96-pres: 200
Depth of sampling (m)	50	50	50
Contact person	Roger Harris/X. Irigoien	Luis Valdés	Maite Alvarez-Ossorio
Email address	rph@ccms.ac.uk	luis.valdes@st.ieo.es	maite.alvarez@co.ieo.es
Location of data	PML/CCMS	Database SIRENO IEO	Database SIRENO IEO
Observations (*)	Later samples in process		

ANNEX 6 – LIST OF INDICES OF POTENTIAL VALUE FOR ASSESSMENT GROUPS

List of Indices of potential value for understanding the zooplankton dynamics and ecosystem functioning

Indices	FISHERIES MANAGEMENT	CLIMATE CHANGE	ECOSYSTEM HEALTH
NAO	@@	@@@	@
Gulf Stream North wall deviation	@@	@@@	@
Air Temp. & Sea Surface Temp	@@	@@@	@
Dif. of Annual SST (Max-Min)	@@	@@@	@@
Stratification index	@@	@@@	@@
Turbulence index*	@@	@@@	@@
Upwelling index	@@@	@@	@@
Freshwater discharges*	@@	@@@	@@
Stoichiometry of nutrients	@	@	@@@
Chlorophyll (annual mean)	@@	@@@	@@@
Timing of phytopl. Bloom	@@	@@@	@@
Diatoms/Dinoflagellates	@	@@	@@
Timing of Zoopl. growth season	@@@	@@	@@
Duration of Zoopl. growth season	@@	@@	@@
Abundance of copepods	@@	@@	@@
Abundance of Calanus	@@@	@@@	@@
Zoopl. biomass/Chlorophyll	@	@@	@@
Copepoda/Cladocera	@	@	@@@
Individual weight	@@	@@	@@
Mean body size*	@@	@@	@@
Slope of Norm. biomass spectrum*	@@	@@	@@@
Species Richness	@@	@@@	@@@
Diversity	@@	@@@	@@@
Shifts in timing of fish spawning	@@@	@@@	@@
Fish eggs and larvae abundance	@@@	@	@
Larvae ratio of RNA/DNA	@	@	@
Larvae Condition index	@@	@	@@

@ = low @@= medium @@@= high
* Indices added after the meeting

ANNEX 7 – LIST OF GEARS AND DEPOYMENTS OF SAMPLING DEVICES DURING THE SEA-GOING WORKSHOP

Instruments Used During the Sea-Going Workshop

Net systems:

1-m2 Mocness
10-m2 Mocness
1-m2 Bioness
MIK
Multi-net
Bongo nets
WP-2 net
LHPR
CPR
Gulf III/OPC
YF trawl
IKMT

Other sampling systems:

In *situ* camera system
OPC
CTD/Rossette
Light profiling gear (spectral radiometer)
Continuous surface irradiance meter

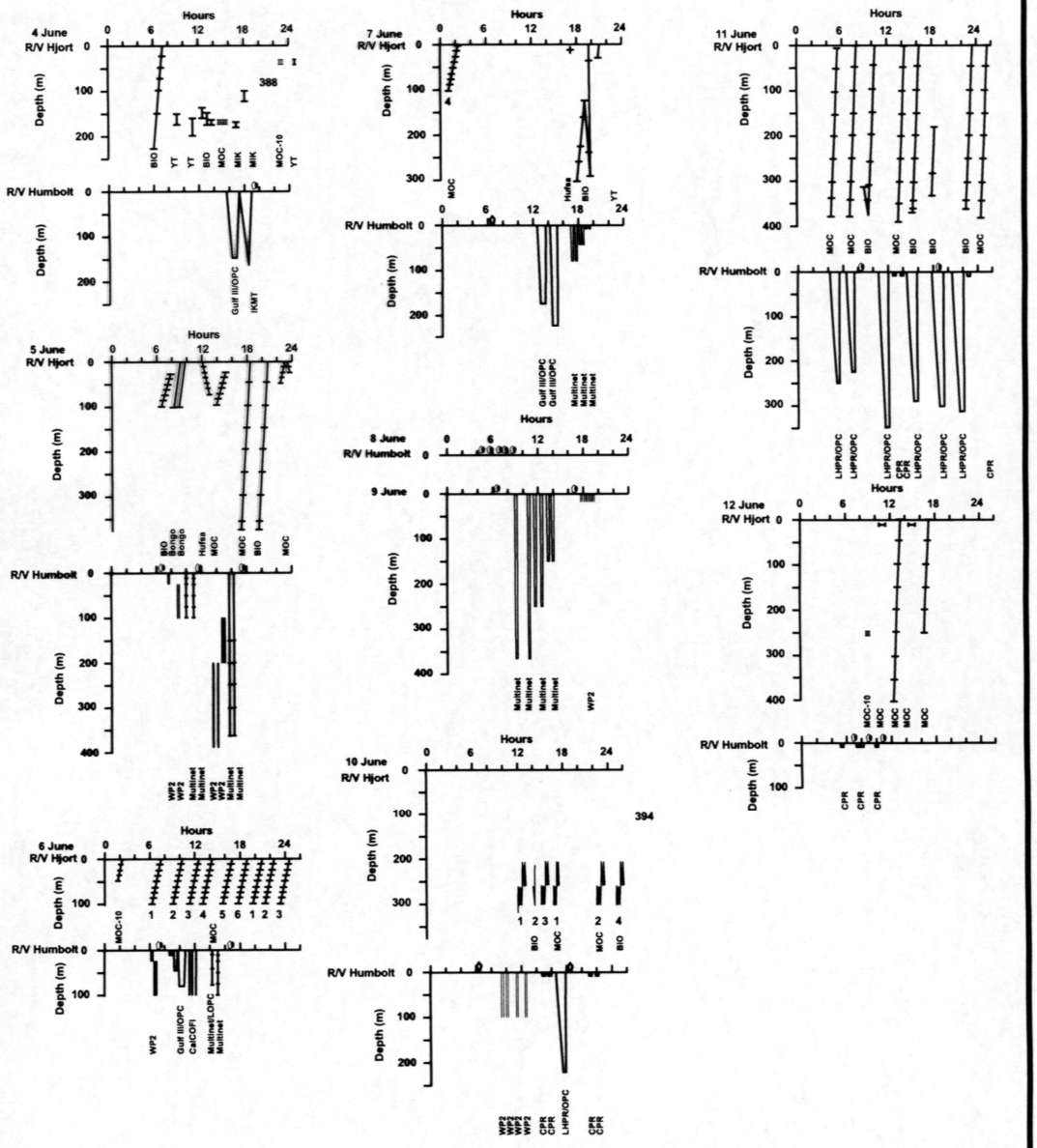
Pumps:

Hufsa pump

Acoustics:

EK500, hull mounted, with transducers operating at 18, 38, 120, and 200 kHz. The first three were split beam transducers.
EK500, towed body deployed from center-well on RV Hjort, with a 38 kHz split beam transducer.
ADCP operating at 150 kHz.
Simrad sector scanning sonar operating at 2 MHz (Mesotech)
Portable EK 500 operated with a 120 kHz split beam transducer.

1993 Workshop-At-Sea Time Table of Events



ANNEX 8 – CONCLUSIONS AND RECOMMENDATIONS FROM THE ZOOPLANKTON TAXONOMY WORKSHOP

Workshop on Zooplankton Taxonomy
Wilhelmshaven, Germany

14–17 May 2000

Conclusions and Recommendations

I The group concluded that for general use the ICES identification leaflets are still one of the most useful compilations of marine plankton for the North Atlantic. Despite recent a number of the ICES identification leaflets require revision.

- The Workshop participants recommend the Working Group on Zooplankton Ecology to take initiative to approach people willing to revise the identification leaflets.

II The Workshop participants recognise the opportunities that electronical media offer in terms of maximising the distribution of information to the scientific community.

- In relation to this the Workshop participants recommend to get the identification leaflet available as pdf-files downloadable or on CD-ROM.

- Secondly, the workshop participants recommend that ICES should collaborate with ETI to breadth the information and general usefulness and appeal of marine species identification for the use of training courses.

III The Workshop participants concluded that taxonomist and ecologists should be encouraged to more directly interact.

- To facilitate better results in this field the Workshop participants recommend compiling and administering a mailing list. For the next two years this will be administered by H. Fock (AWI, Bremerhaven).

IV The Workshop participants agree on that to compile an up-to-date list of European copepod species for European regional seas compiled by the ERMS project has been a highly valuable effort. A draft list provided to the Workshop was examined and the Workshop participants will communicate with the authors to further update and include species not yet included in the list.

- The use of the list will be further improved if additional information on the literature and the systematic is included. The list should be provided in alphabetical and phylogenetical order. It should be considered to link it with a computerised coding system.

V Juveniles: Most taxonomical work is related to ecological questions. One of the pressing concerns of field ecologists is the lack of description of juvenile stages.

- The Workshop participants regard it as a priority that the marine science community puts effort into defining and describing developmental stages of marine copepod taxa. For this purpose a compilation of full descriptions is necessary. Furthermore the identification leaflet of the nauplii should be revised.

VI The lack of comprehensive identification keys for the plankton in the ICES areas often acts as a barrier to ecological work. The Workshop participants recognise the excellence of the edition of the 'South Atlantic Zooplankton' (ed. D. Boltovskoy).

- The Workshop participants feel the need for the marine policy makers to give funding to prepare such descriptive volumes as a follow-up to the ERMS initiative for the ICES. Such initiatives are already apparent

in the Western Atlantic and other seas. The Copepoda would be a good starting point. For parasitic copepods this has already been achieved (RAY Society).

VII Concerning molecular genetics the workshop participants agreed on to initiate activities to foster fieldwork in a way to provide a better basis for the application of these techniques. In general, molecular systematic will profit from comparison of analyses based on more than 1 gene or gene portion. For intercalibration purposes, standard taxonomic material should be shared among the laboratories.

- This includes to archive subsamples from each cruise (1/10 to 1/20) and preserve the sample in 95 % alcohol, both for qualitative and quantitative purposes.

- This includes exchange of information about samples and experts interests. The ICES Working Group on Zooplankton Ecology is asked to assist with workshops and information database. Based on the archival samples, new proposals and thesis works can be launched.

- This includes to develop a DNA sequence database for calanoid copepods, after that taxonomic experts have identified the taxa. Sequencing of certain genome parts should be accomplished (e.g., mtCOI).

- This includes the development of protocols for species' identification, in particular for ecologically important but morphologically indistinguishable species. Multiple approaches are available for Calanus. The goal is for oceanographers to be able to use these techniques without molecular extended expertise. Different techniques are needed. For gut contents analysis the hybridisation with probes is recommended, whereas for the analysis of generic variability restrict and competitive PCR are appropriate.

ANNEX 9 – POSSIBLE KEY QUESTIONS FOR THE 2002 OCEANOGRAPHY COMMITTEE JOINT MEETING

(This Table has been produced by Steve Hay and the questions are addressed to the Working Groups and Study Groups and Steering Groups of the Oceanography Committee).

ICES/GLOBEC Working Group on Cod and Climate Change	Given observed changes in distribution, spawning stock biomass and catch per unit effort, what are the environmental correlates/regime shifts noted and what are the other likely population and food chain consequences of these?
	Given observed changes in recruitment, what links are there to availability and suitability of spawning sites/habitat, egg and larval production and survival and what are the consequences for resource allocation to other species?
Working Group on Recruitment Processes	There are basic questions on the relationships between benthic ecology and productivity with ecology and productivity in the planktonic systems overlaying and resourcing the benthos. Do time series of meroplankton reflect changes in phytoplankton production and how well do they reflect production in adult benthic populations?
	There is increasing evidence that for major demersal species anyway and probably for many pelagics, such as herring or small forage fish, the developmental period most critical to recruitment may not be the egg/larval phase but later, post metamorphosed O-groups. These have poorly known shelter and overwintering behaviours, survival strategies and habitat/feeding dependencies and adaptive ranges. Studies of these should involve plankton/benthos joint approaches and be very well served by running against a monitoring site background of environmental and plankton data.
ICES/IOC Steering Group on GOOS	Questions of scales and sampling often determine the utility of the data. Sampling strategies are important and may be essential if monitoring data is to be successfully assimilated into broader models or datasets
Working Group on Marine Data Management	There are extensive time series data for marine fisheries and hydrographic records. What data should be included in time series and discrete studies for plankton and in what form?
	What coding system can be adopted as a standard which will allow ecological extensions to taxonomic information; e.g., species, taxonomic groups, trophic groups counts including sex and developmental staging, size, condition, chlorophyll, dry/wet biomass, biovolume, C:H:N:P, RNA:DNA, Lipids, Protein, Rate Measures etc?
	What are the implications of modern data assimilation techniques for the average field or lab generators of data sets?
	Is there a conflict between data rights of those who initiate projects, collect and analyse their samples/data; and those who would use these data in syntheses or in support of their own work?
	Should there not be better collection of data/databases of experimental results and process studies, which would complement the field observational datasets?
	How much of the T/S and other hydrographic data collected in biological sampling programs is contributed to hydrographic databases such as ICES?
	Available data needs to be more widely advertised and less tightly held within disciplines. Hydrographic, hydrologic, chemical and meteorological data all are necessary but not sufficient for explaining biogeochemical fluxes in inshore and offshore regions. Living organisms drive and modify the fluxes, yet there often seems little coherence between the biology and physics/chemistry in the way, particularly long term, data sets are derived and collated. Should database managers have a more proactive role in promoting collaborative syntheses of the datasets they nurture?
Steering and Study Groups	Exist to generate and refine questions in relation to their own problems, so will not need help from us?

Study Group on Multispecies Predictions in the BalticI	What do the model makers think we do well/badly, what do they reckon we should be concentrating on? How do you keep up with demand for data on one hand and contend with the worry of oversimplification versus tractable parameter sets on the other. Why are modelling meetings only for modellers or the few who are sufficiently mathematically competent? There is a need to communicate with and involve a wider audience and range of interested parties. This runs alongside the need for coordination of biological datasets with others.
Working Group on Oceanic Hydrography	What are the consequences of ocean climate changes for plankton processes and community structures?
	Can hydrographers provide key regional descriptions/indices of changes in current systems, volume transport, seasonal timing in temperature/salinity variation, stratification patterns and the distribution and intensity of fronts/upwelling systems?
	Could biologists, fisheries scientists etc. relate any such descriptions to changes in distributions of biological events, indices, species, communities and productivity?
WGPE	Discuss: There is a great need to link routine phytoplankton monitoring to studies of nutrient supply and resupply. Algal process studies have to be short time scale jobs. There are numerous methods which would be useful additions to algal sampling. Primary production at key times, stoichiometric studies C:N:P:Si concentrations and ratios & RNA, Isotope Ratio studies of the seston, parallel studies of protozooans.etc. Anything which will index processes and pathways along with food quantity and quality for the micro and mesozooplankton.
Study Group on an ICES/IOC Checklist of Phytoplankton	What are the patterns of seasonal community structure and production for microheterotrophs and how do these relate to such patterns in phyto and zooplankton population and production cycles?
	What differences are there in microheterotroph dynamics between environmental regimes, high/low energy - tidally well mixed or stratified, temperature/latitudinal differences, seasonal/lifecycle adaptation, overwintering etc?
Working Group on Seabird Ecology	There are also many long time series of seabird population counts and hatch data. What are the prey species and seasonal timings, in relation to plankton data?
	The seabird people and data are doubtless exemplary, but there is a real lack of information and incorporation into models of other predators influence and top down controls on ecosystem productivity. This area should command much greater attention in areal surveys, seasonal studies and long term plankton monitoring. Much is known about the general biology and physiology of invertebrate predators but very little about their abundance and distribution or seasonality/life cycles, and less about their effects on the population dynamics of secondary producers or their role in particle flux or in nutrient regeneration.
Working Group on Zooplankton Ecology	**Biological sampling and operative oceanography. How can the phytoplankton and zooplankton be a component of GOOS? (original key question from Working Group on Zooplankton Ecology 2000)**
	Identification of a set of biological indices to characterise the ecological status of the marine environment (original key question from Working Group on Zooplankton Ecology 2000)
	What have we learned from the time series programmes? (original key question from Working Group on Zooplankton Ecology 2000)A major point is that they are complex data, often requiring comparative analyses and correspondences to be established with “far field” or external data to interpret findings. Joint revision, with other Oceanography Committee groups, of monitoring activities carried out in the different working groups, and of how these may be presented on the web or otherwise made more accessible.
	What should we do about the microplankton (20–200μm). These are what actually constitutes often >50% of zooplankton productivity, and is the most common fish and invertebrate predator food, yet few monitor this size fraction. Even a bulk biomass for this fraction tells a lot about the community productivity and key species egg/naupliar counts would be excellent.

ANNEX 10 – MINUTES OF THE ICES WORKING GROUP ON ZOOPLANKTON ECOLOGY AND WORKING GROUP ON PHYTOPLANKTON ECOLOGY JOINT MEETING

Bergen, Norway
28–29 March 2001

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

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1 OPENING OF THE JOINT MEETING

The joint meeting was held at the Institute of Marine Research (IMR) at Bergen, 28–29 of March and was attended by 8 members of the ICES Working Group on Zooplankton Ecology:

Roger Harris, Plymouth Marine Laboratory, Plymouth, UK	rph@pml.ac.uk
Steve Hay, Aberdeen Marine Laboratory, Aberdeen, UK	S.Hay@marlab.ac.uk
Webjorn Melle, Institute of Marine Research, Bergen, Norway	webjoern.melle@imr.no
Philip (Chris) Reid, SAHFOS, Plymouth, UK	pcre@pml.ac.uk
Doug Sameoto, Bedford Institute of Oceanography, Dartmouth, Canada	SameotoD@mar.dfo-mpo.gc.ca
Luis Valdés, Instituto Español de Oceanografía, Santander, Spain	luis.valdes@st.ieo.es
Peter Wiebe, Woods Hole Oceanographic Institution, Woods Hole, MA, USA	pwiebe@whoi.edu
Hein Rune Skjodal (only last day), Institute of Marine Research, Bergen, Norway	Hein.Rune.Skjoldal@imr.no

and by 9 members of the ICES WGPE:

David Mills, CEFAS, Lowestoft Laboratory, Lowestoft, UK	d.k.mills@cefas.co.uk
Lars Edler, SMHI, Ocean Lab. Angelholm, Sweden	lars.edler@smhi.se
Kristinn Gudmundsson, Marine Research Institute, Reykjavik, Iceland	kristinn@hafro.is
Francisco Rey, Institute of Marine Research, Bergen, Norway	francisco.rey@imr.no
Claus Durselein, University of Oldenburg, Oldenburg, Germany	duerselen@icbm.de
Ted Smayda, Grad. School Oceanogr, Univ. Rhode Island, Kingston, USA	tsmayda@gsosun1.gso.uri.edu
Peter Bot, Nat. Inst. Coastal Marine Management, Den Haag, Netherlands	P.V.M.Bot@rikz.rws.minvenw.nl
Harri Kuosa, Institute of Marine Research, Helsinki, Finland	Harri.kuosa@fimr.fi
Guy Hällfors, Institute of Marine Research, Helsinki, Finland	Guy.hällfors@fimr.fi

Dr David Mills was charged of conducting the sessions and he mentioned that the joint meeting was largely demanded and that it is very welcome and timely. The development of working links between both groups has been mentioned frequently in the past and this was an excellent opportunity to tackle an agenda of common interests.

2 ADOPTION OF THE AGENDA

The agenda was discussed and agreed at the last year meetings of both groups and then adopted as a resolution at the Annual Science Meeting in Bruges (C.Res. 2000/2C06). The agenda included the following points for discussion:

I) Limits to modelling phytoplankton – zooplankton interactions
II) How do characteristics of phytoplanktonic diet (size, morphology, physiological condition, toxicity) influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?
III) Can a collapse in grazing pressure lead to symptoms of eutrophication?
IV) Ways of improving the phytoplankton and zooplankton components in GOOS
V) Consider the scientific and operational merits of inclusion of primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes

Links between Working Group on Zooplankton Ecology and Working Group on Phytoplankton Ecology were also discussed reflecting the desire of ICES for these groups to consider merging (point for discussion No. VI).

3 DISCUSSION

3.I) Limits to modelling phytoplankton-zooplankton interactions

D. Mills introduced the topic with a presentation beginning with the question “Why model?” Modelling falls into two categories: Diagnostic, which are used to increase understanding of the processes of interaction between phytoplankton and zooplankton, and Prognostic, which are used to assist in making predictions. Likewise, two approaches were described: one, which involves physics, nutrients, and phytoplankton with a focus on phytoplankton dynamics from a mass balance point of view. Here zooplankton are treated as a loss term. An example was given of using CPR observations as a forcing function. Problems with this approach include deriving grazing pressure from measures of abundance, determining the extent of selective feeding and food quality, and acquiring adequate data necessary to establish boundary conditions and to do model testing. The other approach involves food web dynamics and focuses on energy flow. Complexity in this case rules out a mass balance approach and the computational constraints require that some of the complexity be eliminated. This is especially true for 3D modelling efforts. There are significant problems in

the incorporation of age or stage structure in models that reflect the real world situation. These can, to some extent, be handled in 1D models, but these formulations are sensitive to horizontal dispersion. For 3D spatially implicit models there are significant limits to the level of complexity that can be handled. Issues such as knowledge about the physiological response of individuals to a rapid fluctuations in autotrophs and the availability of field data that provide enough information about larval stage development, individual physiological condition, and taxonomic identity, to a significant extent limit the development of the models of phytoplankton-zooplankton interactions.

P. Wiebe followed with a brief description of the modelling efforts in the U.S. GLOBEC program on Georges Bank. In this program, the primary objective has been to understand the physical and biological forces which regulate the distribution and abundance of zooplankton using the population dynamics approach, that is through an understanding of their birth rates, growth rates, and death rates. Given the resources available to conduct the study, the effort has been focused on four target species, egg and larval stages of cod and haddock, and the copepods, Calanus finmarchicus, and Pseudocalanus spp. While a population dynamics approach requires knowledge about both predators of the target species and their prey, the level of detail about the dynamics of phytoplankton production and species abundance/distribution has been limited. Modelling has focused primarily on the development of high resolution hydrographic models coupled with population based biological models of the target species as well as NPZ models, but there has been little focus on phytoplankton-zooplankton interactions of the kind being discussed in this session.

T. Smayda raised the issue of phytoplankton abundance and size distribution control by grazers and he expressed concern that the phytoplankton research community has not benefited very much from the modelling efforts to date. This led to a discussion about the spatial scale that the modelling targeted, which can range from individual interactions between a phytoplankton cell and a grazer, to the basin scale where the forces of climate variation are thought to be imposed on the observed patterns in phytoplankton and zooplankton distributions. S. Hay made the point that the different scales of structure have important bearing on the level of detail needed in the modelling. He also pointed out 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. As a note of caution, S. Hay said he was not convinced that a knowledge of the fine-scale details of phyto-zooplankton interactions would help in making decisions about, for example, the number of aqua-culture pens present in an estuary or the output of effluent from a shore-based manufacturing plant. F. Rey commented that the interaction between phytoplankton and zooplankton depends on the size of the organisms, such that there is a big difference between the effects/impacts of mesozooplankton versus microzooplankton on net phytoplankton versus nanophytoplankton. P. Wiebe raised the issue of “Tasty, but toxic” and recent data from laboratory experiments that suggest that phytoplankton species (especially certain diatoms) thought to be good food for zooplankton appear to have ill effects on egg production, egg viability, or larval development. [This issue was picked up later in the day by R. Harris who presented data from his time series station south of Plymouth, England that show no ill effects from the presence of diatoms on the copepod, Calanus helgolandicus, in terms of egg production or egg viability]. This level of phyto-zooplankton interaction is not yet incorporated into most modelling frameworks.

Mills turned the discussion back to models as engineering tools and their usefulness in testing hypotheses. He raised the question about situations where there is a successful outcome to the model work, and the data and model results agree. If one has a good outcome, but has not included other aspects of phyto- zooplankton interactions, what then are the limits of application of the models? The point was that models might be sufficient for one purpose, but not another.

S. Hay said that he would like to see some effort expended to model things that cause unusual occurrences in species or surprises in their abundance. Situations where the field data do not fit the model are where interesting science is to be done. K. Gudmundsen emphasised the need for information from areas other than local i.e., the far field relative to the study area, especially the need for more information from the open ocean. S. Hay supported this saying that factors important to the local system often are driven by or result from the far-field.

Following a lunch break, the group returned to this topic by addressing the question “what action or recommendations come out of this joint discussion?” P. Wiebe pointed out that this topic (Modelling of phyto-zooplankton interactions) was really beyond the collective expertise of this group and that the topic must be the subject of future discussion and theme sessions when modellers are present. S. Hay made the point that models are great, but we need collective exchange of information and we need to make joint data collections to look at phyto-zooplankton interactions. This is especially important with respect to studies of climate change.

The discussion turned to the possibility of having a mini-symposium or a theme session on this topic, but there was some question about the response of the community to this proposal. F. Rey raised the issue of what kind of models were under consideration - conceptual versus mathematical models. He wondered if there was not a need for more integration in these different aspects of the problem. D. Mills thought that there already existed a large “shopping list” of items to be incorporated into models.

T. Smayda turned the discussion back to a more biological basis when he suggested that models only help us understand abundance changes phytoplankton and zooplankton, and very little else. Zooplankton and phytoplankton workers view the grazing problem quite differently and the common ground needs to be developed more. Modellers should play a role in fostering this overlap. As an example, he said that classical zooplankton grazing falls apart when diatoms are gone from a system. S. Hay picked up on this point. Although he has measured egg production rates of copepods in the laboratory, he has great difficulty relating these measurements to field production because of the issues of variable phytoplankton species composition and food quality. H. Kuosa thought we were getting bogged down in details and the modellers want to know how to simplify - how to develop simple conceptual models amenable to mathematical expression. The issue is how to get the modellers to work with us. He 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. Getting modellers with models and ecologists with data together in a workshop could be useful. He added, however, we are not the people to do this, but we know the people that could do this. D. Mills also liked this idea as opposed to a symposium where often there is a one-way exchange of information and he thought that both working groups should have this as a recommendation. The time frame for such a workshop would be on order 18 to 24 months (i.e., to occur in 2003). Such a workshop could be tied to a joint meeting of our two working groups and would be an extension of this group meeting.

The discussion then turned to the issue of inter-sessional activity to promote this idea and who might be involved it. P. Wiebe pointed out that the WGSS had been reformulated to have a more focused effort in the area of modelling and that members of that new group should perhaps be involved. S. Hay said he was quite interested in this project because he needs a hydro-biological model for his work. He expressed interest in participating with the working group chairs on organising the workshop.

Some brainstorming on possible modellers that should be asked to participate ensued. Among the names voiced were John Walsh (Florida, USA), Dag Asknes (IMR, Bergen, Norway), Einar Svendsen (IMR, Bergen, Norway), Arnold Taylor (PML, Plymouth, UK), Paul Tett, (UK) M. Fasham (UK), Cisco Werner (UNC), and Herman ??(Germany).

R. Harris said that it would be useful to put together integrated data sets of nutrients, phytoplankton, and zooplankton time-series in preparation for such a workshop. H. Kuosa said that he thought a mini-symposium or theme session would be useful to have to get a workshop underway. D. Mills thought an important task was to identify the people doing the modelling and the "owners" of data sets the modellers are looking for. He asked, "What's the right mix of these people at a workshop?" He noted that in a sense, the Working Group on Zooplankton Ecology is already working to identify such data sets in the preparation of monitoring programs throughout the North Atlantic. S. Hay once again called attention to the lack of theory for broad ecological themes. R. Harris supported this saying that there was a strong need for more advanced theory for marine ecology. S. Hay provided a word schematic linking Theory and Practice to Field and Process Research to Modelling (both theoretical for ecological purposes and applied for management purposes). D. Mills stressed the need to make a connection to OSPAR related or sponsored modelling work in the process of defining the scope of the workshop. Defining the scope was identified as a very important task, one that needed to be completed with much more detail inter-sessionally. T. Smayda asked if within the modelling workshop the items associated with the second discussion topic for this joint meeting (i.e., influence of characteristics of phytoplanktonic diet on zooplankton ingestion rates) would be considered? D. Mills replied that modellers need to work with field and experimentalists to define the next generation of models and that these items must be considered.

So the recommendation from the joint group was to hold a workshop on this topic in 2003 and that a commission from both working groups would be created with S. Hay making the initial contacts.

3.II) How do characteristics of phytoplanktonic diet (size, morphology, physiological condition, toxicity) influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?

Dr Harris presented a time series analysis from Eddystone Reef. This time-series showed potential effects of different food quality on zooplankton egg production. The working groups discussed jointly on the potential effects of nutrition on copepod dynamics and the importance of suitable material compiling both phytoplankton and zooplankton dynamics. Several key questions on zooplankton population dynamics that obviously merit closer work on the effects of food dynamics were identified. Dr Reid showed his material on phytoplankton colour in North Atlantic, which provided insight on the long-term changes of zooplankton food sources. The joint working groups provided resolution that all existing long time series of phytoplankton are extremely useful in trying to evaluate changes in grazer populations. Thus it was pointed out that e.g., the closure of Dr Smayda's long time series in Narragansett Bay is very worrying and all measures on its continuation should be considered. As the result of the session a plea for the rescue of Dr Smayda's long-term time series was agreed to be made. The issue proved to be so important that it will be taken as a ToR on both groups in 2002 with special attention on its role in the planned workshop (WGPE; Working Group on Zooplankton Ecology and modellers).

3.III) Can a collapse in grazing pressure lead to symptoms of eutrophication?

One of the established criteria for assessment of eutrophication is the presence of elevated concentrations of phytoplankton biomass. For example concentrations of phytoplankton greater than 10 mg m^{-3} persisting through the summer have been identified by an expert group in the UK as one of the symptoms indicative of eutrophication. This discussion item focuses upon the mechanisms that may lead to elevated phytoplankton biomass, a symptom of eutrophication.

It is clear that if not light limited the phytoplankton community responds to nutrient enrichment by increased growth rates with a resultant increase in biomass. However, the expression of increased growth rates as an increase in biomass will only occur when rates of biomass loss (e.g., grazing, sinking) are lower than growth rate. Quantitative measurements of loss rates are difficult to perform in the field and their interpretation complicated by considerable spatial and temporal variability.

Linkages between phytoplankton growth and the reproductive capacity of grazers to respond to increased food supply are usually out of phase; as a result blooms can develop in the absence of grazing. Interspecific relationships such as competition and growth rate differences between phytoplankton species probably play a minor role, but they may result in a species composition that is grazed less effective because of poor food quality or because they contain toxic components. Additional complications in understanding bloom dynamics will arise as a result of size selection by grazers.

A preliminary conclusion that a collapse in grazing pressure can leads to symptoms of eutrophication in local areas because of differences in distribution and dynamics between phytoplankton and grazers. It should be noted that elements of this discussion will be revisited in the proposed workshop to be held in March 2001 in the Netherlands.

3.IV) Ways of improving the phytoplankton and zooplankton components in GOOS

D. Mills opened this session by referring the group to the documents output by EUROGOOS, particularly the publication No.15 Biological Observations in Operational Oceanography. This document contains justifications, outlines and recommendations for the programmes and materials which are needed to implement the GOOS initiative. These are mainly physical and chemical observations but specifically include the need for biological information.

David then gave a short presentation of the Smart Buoy systems, which he and his colleagues are developing and deploying at National Marine Monitoring Programme sites in the southern North Sea. The talk was illustrated by three examples of data from the SMART Buoys deployed in the Thames estuary, Southern Bight and a Buoy deployed in a collaborative effort with the Netherlands RIKZ, offshore of the Netherlands' coast. This is a high-resolution multisensor sampling system, which can collect simultaneous water samples for physical, chemical and biological measurement. It is very apparent that such technology is both a major step forward and a valuable enhancement of existing monitoring programmes. In line with the existing global meteorological net of monitoring sites and instruments, there could be developed an integrated network of sites where ocean physics/chemistry and biology will be monitored. This can be done at appropriate resolutions, at scales from hours to years, with high-speed remote data telemetry and with integrated data management. David noted that such systems collect at high resolution, allow close integration over spatial and temporal scales resolve cyclic and episodic events and collect multidiscipline datasets. Also, modular developments allow new approaches to dealing with problems such as chronic under-sampling in monitoring and with ground-truthing satellite data.

The SMART buoy data presented were discussed and various points were raised. T. Smayda noted that each buoy, sampling surface waters, costs approximately £60,000. This is expensive and to some degree the patchy temporal nature of such variables is already known. It is therefore possible that the high tech and expensive solution may be an over-investment in temporal resolutions, which might lead to under-investment in spatial resolution and an unfortunate under-investment in the more simple monitoring technologies and efforts, which make up most of the financially struggling long term time series. David pointed out that relative to ship time costs the buoy systems were inexpensive. He also noted that there were important political agendas involved and that the developments were to an extent supported by and directed towards important policy decisions and directives. C. Reid noted that we need both high-resolution work and broader and lower resolution spatio-temporal data. P. Bot raised the point that the buoys need considerable technical support, monthly servicing and have some problems with biofouling but yielded good data nonetheless.

Chris noted that the IOC panel on living marine resources had been reorganised and R. Harris acknowledged that he was a member of the now IOC Coastal Ocean Observing Panel. The ARGO floats programme was mentioned, which had some 2500 deployments around the world but did not collect biological data. It was noted that the need to merge

monitoring efforts and data was recognised and that there were reviews available. The aim of the Working Group on Phytoplankton Ecology and Working Group on Zooplankton Ecology should be to jointly add biology to the physical and chemical monitoring. There is a problem however in that biological samples take time to analyse and so the requirements, of GOOS for example, for as near real time data as possible will be hard to meet. However we should try to direct the attention of the GOOS planning to the ICES Working Group on Zooplankton Ecology Monitoring site plan and data, which should be extended to include sites where phytoplankton and other data are collected. P. Weibe pointed out that technology exists to obtain real time plankton data from size structure analyses devices such as OPC systems. More particularly, with the developments in in-*situ* digital video and image recognition systems, which have been proven in prototype, the possibility to collect real time species data exists now. This technology is amenable to use on towed systems and profiling buoys etc.

The overlap of data was pointed out, i.e., many of the zooplankton sites monitor phytoplankton, physics and nutrients and vice versa. It was noted that the need for indices of environmental health and monitoring data was growing, with initiatives related to Ecological Quality Objectives, OSPAR workshops, Biodiversity Commission etc. P. Bot noted that 10 indices related to such as Fish Stocks and Eutrophication had been identified. C. Reid said that there had been very strong condemnation and notice taken of the problems caused by breaks in monitoring datasets. He cited as examples, the Baltic where an invasive cladoceran had appeared at such a break, and the Canadian CPR series break when the cod stocks declined. Such breaks seriously affect the data analysis and explanatory power of time series. There was also great concern noted by all of the Working Group members when T. Smayda said that his 37 year time series of sampling in Narragansett had been suspended two years ago. This is felt to be a serious loss since this important series was one of the very few continuous plankton monitoring datasets in the world. There is, it was felt, a near crisis in data management, in maintaining continuity, in the investment in practical methods and in developing agreed approaches internationally. There is also a danger that the glamour of new developments and technological fixes may divert resources and attention from current and very valuable initiatives and programmes.

L. Valdes emphasised that we should put our best efforts towards updating and improving the Monitoring Status Report. He pointed out that the report had been presented at the Southampton IOC meeting and had been acknowledged as a way forward in the EUROGOOS report. R. Harris noted that GLOBEC–GOOS linkage is good in areas, though ICES links with the Coastal Ocean Observing Panel are not obvious. Roger also pointed out that GOOS is user driven, intending to get the users to pay, and as yet there are not many users of Biological information. He felt that the initiative of the ICES Monitoring Status report, especially with the agreed incorporation of the phytoplankton monitoring, is now a recognised focus and sensible way forward. D. Mills emphasised the need to identify and inform end users in government and industry, to encourage funding and commitment to the monitoring programmes.

At this time Heine Rune Skjoldal, founding chair of the Working Group on Zooplankton Ecology and chairman of the newly formed ICES Advisory Committee on Ecosystems (ACE), arrived to present to the group his vision on Ecosystem Perspectives. He brought to the groups' attention the existence of an ICES/OSPAR/IOC/EuroGOOS Steering Group and the intent to hold and maintain a multi-body discussion and initiative, with the challenge to bring both Fisheries Community and Environmental Management perspectives together.

He pointed to an ICES/OSPAR/IOC/EuroGOOS Workshop, on a North Sea Ecosystem Component for GOOS, to be held in Bergen 5–7th September 2001. The aim is to prepare a strategic plan for a co-ordinated and harmonised observation network, which integrates fisheries and oceanographic data, to progress the development of an ecosystem approach to North Sea management and to increase the efficiency and cost effectiveness of national and international monitoring systems. The resulting plans are to be presented to the Ministerial Meeting of the North Sea in March 2002. H. R. Skjoldal noted that it was widely agreed that co-ordination and management of monitoring data is poor, and that although some information is submitted to bodies such as OSPAR, there is much data that is not produced or contributed. He felt that the contacts, discussions and initiatives of the ICES Working Group on Zooplankton Ecology and Working Group on Phytoplankton Ecology played an important role in the co-ordination and syntheses of national information.

H. R. Skjoldal then gave a very interesting presentation of his role and views as chairman of ACE and of his Ecosystem Perspective ideas, which was well received by the Working Group members. Some key points were:

- That ICES ACE would promote integration and synergies between stakeholders involved in the chain of maintaining Research, making integrated Assessments, providing clear and co-ordinated Advice, applying adaptive Management and in the practical Policy Objective Setting which sets regulations to conserve stocks/environments or to reduce/avoid eutrophication.
- That for the Environmental area, Assessment and Management should be brought into as close alignment as they are in Fisheries.
- There is a need to separate anthropogenic influences from natural variability.
- There is need to distinguish the effects of different human activities.

- There is need for a more integrated system of ecosystem monitoring and assessment.
- There is a need to collaborate in developing appropriate and meaningful Indices of Ecosystem Health, which address issues of Fisheries and Environmental Management.

There followed some questions and discussion about Heine Rune's presentation and on the important product, which the ICES Plankton Monitoring Status Report should become. The Working Group on Phytoplankton Ecology also unanimously confirmed their agreement to contribute to this report as soon as possible. Again the problems with producing biological data in time were raised. However the consensus view was that this should be achievable on an annual basis once the report had been set up and needed only revision. It was emphasised that the updating of this Annual Report would provide a useful and tangible product focus for the Working Groups and a focus for communication. There was concern expressed about the support ICES was giving in terms of making the Report more fully available on its Web Site, with links to other monitoring site data and managers. The Web it was agreed was the quickest and best medium for dissemination of the report and for obtaining feedback, PR profile and further contributions. P. Weibe made the point that it is a hard and time-consuming task to get data together from around the ICES area. He stated that there is a need for National Delegates and ICES Administration to provide more practical support and recognition of the importance and difficulties faced by Working Group members who largely voluntarily are contributing their time, effort and expertise. Throughout this discussion, there was strong concordance on the importance of maintaining independent, expert, and in future more collaborative, Working Groups on Zooplankton and Phytoplankton Ecology, whose inputs and products contribute to the advisory focus of the ICES Advisory Committees and foster international collaboration.

3.V) Consider the scientific and operational merits of inclusion of, respectively, primary production measures and zooplankton studies in JAMP eutrophication monitoring programmes

This topic was not dealt with in detail during the joint meeting as elements of this discussion had been undertaken by Working Group on Zooplankton Ecology and Working Group on Phytoplankton Ecology for TOR's in previous meetings and partially due to lack of time. It was also noted that elements of this topic are likely to be addressed in the proposed workshop for March 2002.

During a recent OSPAR meeting a list was drawn up with several hydrodynamic, biological, and chemical parameter, which should be taken, into account for monitoring measurements. A decision will be made as to which items will be included in future. The chair of the Working Group on Zooplankton Ecology last year wrote a letter to the ICES/OSPAR ICES/OSPAR Steering Group on Quality Assurance of Biological Measurements Related to Eutrophication Effects pointing out the necessity to measure zooplankton and phytoplankton parameters (including primary production) in water quality monitoring programs. The members of Working Group on Phytoplankton Ecology agree with this suggestion.

It was noted that such additional measurements as proposed would be relevant to assessments of biological effects arising from the introduction of advected nutrients. For example, it is suggested that from the southern part of the North Sea nutrients are transported to the stratified waters of the Skagerrak and Kattegat where possible impact include increased primary and secondary production.

3.VI) Consider the possibility of merging

Links between Working Group on Zooplankton Ecology and Working Group on Phytoplankton Ecology were discussed reflecting the desire of ICES for these groups to consider merging. From the ensuing discussion it was agreed that closer links were desirable. One area of collaboration identified was annual status reports on standard sections and time series stations of phyto- and zooplankton in the ICES area, based on the report produced annually by the Working Group on Zooplankton Ecology. Working Group on Phytoplankton Ecology members agreed that this effort was both meritorious and manageable with appropriate data readily available from a number of Working Group on Phytoplankton Ecology members. Summary data is the prime requirement for the report together with metadata. To aid this process it was agreed that copies of this year's status report be provided members of the Working Group on Phytoplankton Ecology, and also relevant minutes of Working Group on Zooplankton Ecology meeting concerning the report. The Working Group on Phytoplankton Ecology will develop standard reporting protocols for use in this effort inter-sessionally with the first status report to be a product of the year 2002 meeting of the Working Group on Phytoplankton Ecology.

With regard to the stronger steer from ICES to consider merging the two groups a number of argument were identified in support of the continued existence of the two groups as linked but separate entities.

Members of the Working Group on Zooplankton Ecology felt that their Working Group was a unique group within their discipline. The members found it useful and productive. Members felt strongly that if the working groups were merged they would pursue their common interests elsewhere and probably outside the ICES structure and to detriment of the ICES mission. It is clear that merging the groups would not necessarily lead to increased participation in the newly created group, as the one member per country rule would immediately lead to lower overall participation. The membership, then, of any new thematic working group was unclear to the meeting. The members of both working groups strongly felt that the critical view of the Oceanography Committee was not deserved and that each Working Group merited continuation.

The need for strong disciplinary working groups was identified in an overview of the structure of the Oceanography Committee presented by L. Valdes and based on previous Working Group on Zooplankton Ecology discussions. He defended the system of the disciplinary groups by pointing out the fundamental value of these groups and suggested that a cross-disciplinary group could be created, but not at the expense of the existing Working Groups. Both groups strongly supported this view laid out in the illustration presented in Annex 4.

PROPOSAL to the Oceanography Committee

The Working Group on Zooplankton Ecology and Working Group on Phytoplankton Ecology strongly oppose the proposed restructuring and in particular recommend that neither of the working groups are phased out and that ICES adopt the dual approach of discipline and cross discipline working group structure as presented in Annex 4.

4 ANY OTHER BUSSINESS

Dr Svein Rune Erga (University of Bergen, Bergen, Norway) gave a guest presentation on the use of optical detection system for the study of fine scale vertical displacement of microalgae in artificial water columns (microcosms). The main points were:

A proper knowledge of the vertical organization of the phytoplankton is of fundamental importance for the understanding of the functioning of pelagic ecosystems. Essential in this context is the existence of vertical gradients in environmental parameters. *In situ* study of phytoplankton is biased by the fact that submersing instruments can disturb or even destroy the fine vertical gradients in species composition and/or cell numbers.

Dr Svein and his colleagues have designed and constructed an optical instrumentation system by which fine-scale vertical displacements of microalgae can be studied in an artificial water column without influencing fine physical, chemical, and biological structures of the water column. This enables to search about the fine-scale behavioural responses of microalgae to vertical gradients in environmental parameters.

He described the main system, presented some test results and concludes that the optical system is able to reveal fine-scale vertical displacements of microalgae and that the system can detect differences in cell densities down to 100 cells ml^{-1}.

A complete description on this system can be found at:

Erga, S.R., Omar, A.M., Singstad, I. and Steinseide, E. 1999. An optical detection system for the study of fine scale vertical displacement of microalgae in an artificial water column. J. Phycol., 35: 425–432.