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REPORT OF THE

ICES WORKING GROUP ON ZOOPLANKTON ECOLOGY

(Including ICES/PICES mini-workshop on Zooplankton Ecology)

Hawaii, USA

17-19 April 2000

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 BACKGROUND AND OPENING OF THE MEETING

The meeting was held at the University of Hawaii (1st and 2nd days) and at the Hawaii Marine Biological Laboratory (3rd day), from 17–19 April at the kind invitation of Dr Mark Huntley.

The meeting was opened at 09:00 on Monday 17 April. Participants were welcomed to the meeting by Dr Mark Huntley,who also explained the local arrangements.

The meeting was attended by 8 members of the ICES WGZE representatives of 6 countries, and by 5 members of the PICES in representation of 4 countries (Annex 1).

2 ADOPTION OF THE AGENDA

The general terms of reference originally formulated for the WGZE were:

a) review and compare the zooplankton ecology of the North Atlantic and North Pacific;

b) discuss and review the published ICES Zooplankton Methodology Manual with PICES colleagues in relation to methods standardisation between ocean basins;

c) report on progress with publication of results from the Sea-going Workshop on Inter-comparison of Sampling Gear and associated data products;

d) consider the development of technology and methodology for zooplankton monitoring in both North Pacific and North Atlantic;

e) continue to develop, with PICES colleagues, operational uses for monitoring activities and environmental indices, in collaboration with fisheries and environmental assessment groups;

f) review plans for a workshop on taxonomy of calanoid copepods;

g) consider plans for the EU ENRICH proposal to further basin-wide synthesis of datasets collected by TASC, US GLOBEC and Canadian GLOBEC, and how this activity can contribute to the Theme Session on Zooplankton - cod linkages at the 2000 ASC.

h) prepare for a joint session with WGPE in 2001 on the development of improved understanding of phytoplankton-zooplankton interactions

Specific TORs formulated during discussions of WG Chairs at the 1999 ASC were:

i) consider, and where feasible, develop data products and summaries that can be provided on a routine basis to the ICES community via the ICES website;

j) examine the 1999 Oceanography Committee Working Group reports 2000 TORs to identify where inter-group input could be provided or required with the view to formulating key questions requiring inter-disciplinary dialogue during concurrent meetings of the Committee's Working Groups in 2002.

During the preparation of the agenda, the colleagues from PICES suggested the addition of a new TOR:

k) organization of a major ICES/PICES/GLOBEC Comparative Zooplankton Ecology Symposium.

As a consequence of the discussions that the ICES Oceanography Committee has had in Stockholm, the Chair of the OCC has demanded an extra task from the WG, which was formulated as follows:

l) Review the objectives and purpose of your WG with the goal of addressing the needs, benefits and disadvantages of merging WGs and forming new ones and justify why your group still should exist.

The agenda for the WGZE meeting was adopted as a resolution of the Annual Science Meeting in Stockholm (C.Res. 1999/2C09), and the WGZE accepted for discussion the new points suggested by PICES and the Chair of the OCC (for details on the meeting programme, see Annex 2).

As stated in the same resolution, the WGZE will report to ACME before its June 2000 meeting and to the Oceanography Committee at the 2000 Annual Science Conference.

In order to make the report more comprehensive, the Chair proposed to rearrange the TORs as follow: TORs for Scientific and technical discussions (a, b, d, e), TORs for reporting on on-going activities (c, f), TORs for discussion on plans for future activities (g, i, h, j, k), and TOR on the current status of the group (l). The WG agreed, and the agenda was accepted.

3 SCIENTIFIC AND TECHNICAL DISCUSSIONS

3.1 The Zooplankton Ecology of the North Atlantic and North Pacific (ICES/PICES mini-workshop on zooplankton ecology)

TOR a: Review and compare the zooplankton ecology of the North Atlantic and North Pacific

Chair: Dr Charles Miller; Rapporteur: Dr Mark Huntley

This informative and comprehensive session contained a variety of representative data sets, presented by numerous contributors. Dr Miller made the first presentation, making broad comparison of zooplankton ecology in both oceans, focused on principal copepod species.

The outstanding difference between the two ecosystems is strongly driven by a difference in phytoplankton dynamics. The Atlantic has a huge spring bloom, generally beginning inshore in February and extending offshore until about May, with minor variations in timing and extent across the northern ocean basin. There is a rich mesoscale structure, with localized blooms predominating in cyclonic eddies. It was noted that, although both BOFS and JGOFS made significant studies which have contributed greatly to our understanding of this system, phytoplankton taxonomy was generally ignored.

Large areas of the Pacific, by contrast, are characterised by the virtual absence of blooms (at least in the eastern basin). This phenomenon is believed to be a result of microzooplankton grazing pressure.

The two oceans thus differ significantly with regard to the adaptations and dynamics of zooplankton populations. The North Atlantic has two species of *Calanus* with widespread distributions, and remarkably large biomasses that unquestionably dominate the system. Continuous Plankton Recorder (CPR) data clearly show that *Calanus finmarchicus* is concentrated in the north and northeast, whereas *C. helgolandicus* is concentrated in the southwestern North Atlantic.

In general, *C. finmarchicus* overwintering stages rest at depths of 400 m (but can be found shallower or deeper). The TASC program has not discovered what cues trigger diapause, and thus it remains unclear what cues drive changes in the vertical distribution of these resting stages. After the winter solstice, late copepodite stages moult, meet and mate at depth, and inseminated females proceed to surface waters. In some populations, there is a mass descent of late copepodites after one generation, but other populations remain in surface waters to produce a second, and sometimes a third, generation. This phenomenon is quite area-specific, and generally repeated year-to-year. Even in areas with only one generation, there is often a small fraction of the population that remains at the surface to produce a much less significant second generation.

Calanus finmarchicus populations have three principal loci. From west to east, the first is at Georges Bank and the Scotian Shelf; the second between Newfoundland and Greenland, and spills into the southern Labrador Sea; and the third in the Norwegian Sea. Life history timing differs in these three areas. In the west, the annual cycle begins early (February) and ends early (June). In the central region, the cycle begins late (April) and ends late (October). Populations in the Norwegian Sea are timed in mid-season. There is speculation that these differences in timing may be driven by the timing of the spring bloom, with which there is a strong correlation.

Analogous species of dominant copepods in the western North Pacific are *Neocalanus plumchrus*, *N. cristatus* and *N. flemingeri*, all designated by Vinogradov as "interzonal migrators." These species are very different in their vertical migration and reproductive behaviour than *Calanus*, primarily because they do not require food to reproduce.

N. plumchrus is the most important of the three species in terms of biomass. Males do not feed, and do not ascend to the surface. *N. flemingeri* differs in the nature of its feeding mouthparts; the longer second maxilliped enables more feeding capability; the filter limb is characterized by wider intersetal and intersetule spacing.

N. plumchrus is very flexible in its life history throughout its range. Fulton showed in the 1970s that copepodites of this species in Georgia Strait mature at depth in the early part of the year (January through March), produce eggs at depth, and ascend without feeding. Later research in the open ocean near Station P has shown a very different life cycle. There, CIV copepodites appear in April, followed by CV's in June. Females are present from July through September. The potential for recruitment persists into the winter. Females, which apparently remain at depth, begin to appear spent of eggs in June, and the spawning peak is in October.

In the central Gulf of Alaska region, *N. flemingeri* is much less abundant than *N. plumchrus*, generally by a factor of 10. This species matures by the end of May and, unlike *N. plumchrus*, maturation occurs almost simultaneously in the entire population. Males appear only briefly; females are fertilised in June, and the males rapidly disappear. The ovary is dormant through November, then oocytes develop, and spawning occurs in late January and February. Rather than a rise to the surface, females rise only from about 500 m to 250 m during spawning. *N. flemingeri* is quite flexible in its life cycle. In the Sea of Japan, this species appears to have a 2-year life cycle; the interannual resting stage is CIV, which is larger than in the Gulf of Alaska and also rests at shallower depth.

There are significant observations regarding the body size of both *N. plumchrus* and *N. flemingeri* at Station P. There is a correlation between the copepodite body sizes of both species at any given time. However, there is no correlation between population biomass and the mean body size of either species. Recent data suggest that small body size is correlated with high levels of new production, and large body size is correlated with low levels of new production. Data from Station P shows that the date of the zooplankton biomass maximum has occurred progressively earlier in the year in the past decade; there is a clear correlation with temperature, which has increased over the same period.

Dr Runge asked about the significance of *Oithona* in both oceans, to which Dr Miller replied that recent taxonomic investigations affirm that the same species (*O. similis*) occurs in both oceans, and that its biomass can at times be very significant in the Gulf of Alaska. Dr Runge also asked about the importance of *Metridia* in the Pacific. Dr Miller cited the significant work of Batchelder, showing that *Metridia pacifica* produces three generations per year, with a major gap punctuated in January, when reproduction is initiated. He also pointed out that they are heavily preyed upon by chaetognaths, in fact disproportionately so, perhaps as a result of their extraordinarily active swimming behavior which would create significant opportunities for an ambush predator. Dr Runge noted that *Metridia*, in turn, prey heavily on the nauplii of other copepod species.

In response to a question by Dr Wiebe, Dr Miller commented that the pteropod, *Limacina helicina*, has highly contagious distributions, can be very abundant in winter, and is often found to dominate the stomach contents of certain whales. Dr Napp remarked on the distinct and powerful acoustic backscatter caused by pteropods, and noted their importance in the diet of both salmon and pollock; large amounts of *Limacina* in the pollock diet can lead to a discoloration in the fish flesh, caused by high levels of cysteine and methionine in the pteropod shells.

Dr Harris asked whether tunicates were important in the North Pacific. Dr Miller said generally not, though Dr Napp indicated that appendicularia can be very abundant in polynyas of the Bering Sea. Dr Miller added that Cyclosalpa can be occasionally important. These ascend at night, primarily to reproduce and without feeding webs; near midnight they return to a depth of approximately 70 m where they commence feeding. Dr Miller further pointed out that siphonophores in the North Pacific are not as abundant as in the Gulf of Maine.

Dr Postel inquired whether phytoplankton blooms in the North Atlantic are fully utilised by the zooplankton, to which Dr Miller replied that much of the excess primary production appears to sink and supply the benthos rather than to be consumed by pelagic zooplankton.

The question was raised as to whether *N. cristatus* is a detrital feeder (Dr Runge). This was confirmed by Dr Milller, who remarked on the paucity of organic vertical flux at depths below the range of *N. cristatus*. Flux below these depths is generally dominated by opal, indicating a significant reworking of epipelagic detritus; the significant exception to this normal phenomenon is attributed to the Cyclosalpa, whose large and abundant fecal pellets may "rain" swiftly to the bottom during large but ephemeral increases in salp populations.

Dr Ikeda presented a summary of data on the copepods of the western North Pacific, much of this being recent information based on collections with an opening/closing Gamaguchi net. The Gamaguchi net, which is similar to a Quimper net, has a 60-cm mouth opening, and in Dr Ikeda's recent studies was deployed with 100-micron mesh in five strata to a depth of 2000m. Unlike the HNLC region of the eastern and central North Pacific, areas of the western North Pacific experience very significant phytoplankton blooms. Near the island chain from Hokkaido to the Kamchatka Peninsula, where Dr Ikeda has recently been working, such intense blooms can occur over water depths of more than 5,000 m. Strong blooms may also occur in more offshore regions of the western North Pacific gyre. At Station H the spring bloom, which occurs in March through June, attains levels of >4 mg m^{-3} and is dominated by diatoms.

At Station H, life cycles of the *Neocalanus* species appear to differ significantly from those observed in the eastern North Pacific, although depth distributions are very similar. Relative abundances also differ, with *N. cristatus* dominating *N. plumchrus* by a factor of about two, and *N flemingeri* by a factor of about five. In *N. cristatus*, all developmental stages are present throughout the year; however, reproduction occurs at about 1000 m in December-January, and spawning occurs in winter, producing nauplii that reach maturity by the following autumn. In *N. plumchrus*, reproduction occurs at around the time of the spring bloom, although adults remain at a depth of about 1000 m, like *N. cristatus*. In *N. flemingeri*, reproduction occurs prior to the spring bloom, followed by spawning and maturation, which appears to require 2 years. There appears to be some linkage to spring bloom dynamics in both *N. cristatus* and *N. plumchrus.* In these two species, one can distinguish animals of both "solid" and "transparent" appearance. The "transparent" body type increases near the beginning of the spring bloom, but after the bloom, the "solid" form becomes dominant.

Eucalanus bungii at Station H appears to have a one-year life cycle (unlike the 2-year life cycle is observed at Station P). Adults appear in shallow water prior to the spring bloom and spawn at the surface, though reproduction appears to be sustained by energy stored in the previous year. Nauplii are most abundant at the beginning of the spring bloom and reach the deep overwintering CV copepodite stage by early autumn (September – October).

A comparison of body sizes (prosome lengths) of the three *Neocalanus* species at various locations throughout the North Pacific indicates that *N. plumchrus* is approximately the same everywhere, but that *N. cristatus* is largest in the Japan Sea and Ohkhotsk Sea and *N. flemingeri* is largest in the Ohkhotsk Sea and the Bering Sea. The smallest specimens of both *N. cristatus* and *N. flemingeri* occur at Station P. There is some speculation that some of these differences might be attributable to greater food supplies in the western North Pacific. Dr Ikeda has searched throughout a large North Pacific data set for body size correlations with a variety of parameters, including sea surface temperature, stability, salmon catches, phytoplankton standing stock, and the abundance of both salps and chaetognaths, but has found no significant correlations.

Dr Sameoto presented recent data from the western Northwest Atlantic. He specifically discussed CPR data from (1) the E-line, which terminates near Cape Breton Island in Nova Scotia, and (2) the Z-line, which historically has terminated either on the south coast of Labrador or on the east coast of Newfoundland. Several indices have been determined from the CPR samples in addition to *Calanus finmarchicus*, including total copepods, total euphausiids, dinoflagellates, and the "color" index, which is a proxy for phytoplankton biomass.

There has been a striking increase in dinoflagellates during the 1990's. At the same time, copepod biomass has declined by approximately one order of magnitude. The timing of the spring bloom has also moved to much earlier in the year. The color index shows that the spring bloom on the E-line is now consistently beginning in early winter (December-January), rather than in spring, as was the case in the 1960s. Dr Sameoto also noted that on both the E-line and Z-line the color index is correlated in time, as is the abundance of *C. finmarchicus* CIV and CV copepodites. One interpretation of the data on *C. finmarchicus* suggests that populations of the Scotian Shelf and the Labrador Current could be identical.

Further analysis of the E-line and Z-line CPR data set has failed to demonstrate correlation of any variable with North Atlantic Oscillation (NAO). However, Dr Miller remarked that the NAO is strongly correlated with *C. finmarchicus* abundance in the Norwegian Sea. Dr Wiebe added that Conversi and Piontkovski have found the reverse is true in the Gulf of Maine.

Dr Irigoien presented a hypothesis to explain why the NAO might be correlated with certain biological variables. In the north-western Atlantic, a positive NAO would be expected to lead to more storm activity, which would produce higher upper ocean turbulence and higher rainfall, which in turn should lead to increased riverine flow into neritic regions, accompanied by higher nutrient input to coastal seas. From these conditions, one would expect the diatom: flagellate ratio to be greater in years with a positive NAO.

Examination of a CPR data set from the 1990s appears to confirm the hypothesis. In 1999, during a positive NAO, the diatom: flagellate ratio was very high. By contrast, during the negative NAO of 1996, the spring bloom was dominated by flagellates. Interestingly, no relation was found between the NAO and total microplankton biomass.

Dr Irigoien also discussed a current decade-long data set on the egg production of *Calanus helgolandicus* and its relation to food quality in the English Channel. These data result from a program led by Dr Harris. Analysis of the total data set shows only a weak power relationship between egg production and total "food." However, residuals of this relationship were then calculated and the deviations from the overall mean plotted against the abundance of various subsets of the total microplankton "food". The residual analysis indicated positive relationships between egg production and (1) diatoms, (2) *Phaeocystis* and (3) ciliates, whereas negative relationships were found between egg production and (1) *Gymnodinium aureolum* and (2) coccolithophorids; no relationship was found to flagellate biomass. Egg hatching success showed similarities to these results, with the following order of significance: heterotrophic dinoflagellates > ciliates > dinoflagellates > diatoms > flagellates.

Dr Napp made a presentation regarding the regime shift in the Northeast Pacific, which Art Miller, Nate Mantua and others have clearly shown occurred at about 1978. The most striking correlates of the regime shift include (1) a significant increase in total zooplankton biomass, and (2) a shift of the timing of *N. plumchrus* recruitment and its subsequent biomass maximum to much earlier in the year. It is not clear that the temporal shift in *Neocalanus* biomass has a bearing on fish recruitment, because it is *Pseudocalanus*, *C. pacificus*, *C. marshallae* and *M. pacifica* that are the most important elements of fish larval diets in the Northeast Pacific.

Dr Miller commented that zooplankton species typical of Southern California waters are now being routinely observed off the coasts of Oregon and Washington. Furthermore, populations of these species appear to be reproductive throughout the summer. Further support of this phenomenon was given by Dr Harris, who presented recent data of Peterson showing that *Pseudocalanus minor* off Oregon had a significantly earlier abundance maximum during the 1997 El Niño. Dr Napp indicated that some biological data clearly show the effect of the regime shift, though others do not. However, Dr Miller pointed out that the regime shift has had a strong negative impact on fisheries and the fishery-based sector of the economy in the Northwestern US, though the result appears to be positive in the coastal Gulf of Alaska.

Dr Valdés presented a summary of an ongoing time-series study off northern Spain. Spring blooms in the Bay of Biscay are generally not as intense as they are in European waters further to the north. After the spring bloom, waters are stratified from about April through October, after which a second bloom may occur. Offshore regions are characterized by low zooplankton biomass with a single, relatively sharp peak in abundance; in neritic waters zooplankton biomass reaches higher values, and the bloom period tends to be longer. Principal component analysis of the entire time-series data set shows that the dominant forcing function for zooplankton ecology is the annual solar cycle.

Marked changes have occurred in the pelagic ecosystem off northern Spain during the past decade (1992 to 1998). First, sea surface temperature has increased by approximately 1.5°C. Second; there has been a decreasing trend in the abundance of zooplankton. Third, the spawning period of fishes (notably mackerel) is notably earlier in the year. Fourth, certain species of fishes (e.g. *Zenopis conchifer*) are now being found much further to the north than they were 30-40 years ago; where the northern extent of the range was limited to the Bay of Biscay, the range has now moved into the Irish Sea. Fifth, water column stratification has increased. Finally, species diversity of the zooplankton has decreased. There is a significant correlation between the increase in water column stratification and the decrease in zooplankton biodiversity.

Dr Gislason discussed the region of the North Atlantic surrounding Iceland. This area is characterized by large gradients in both water masses and pelagic ecosystems, reflecting the dominance of Arctic waters to the north and west, and true North Atlantic waters to the south and east. *C. finmarchicus* is by far the dominant macrozooplankter in the seas surrounding Iceland, though its abundance is greatest in North Atlantic waters. To the north, *C. finmarchicus* produces only one generation per year, but to the south it produces two.

There has been a continuous time-series of biological data collected at a series of stations around Iceland since 1961, with samples being taken in May and June. These data show general trends in *C. finmarchicus* biomass that differ between northern and southern waters. To the north, biomass was high in the 1960's, low from 1965 to 1990, and high again in the 1990s. To the south, there appears to be a 10-year cycle, with peaks around 1975, 1985 and 1995. In general, Dr Gislason indicated that the data agree well with the CPR data set for the North Atlantic.

Icelandic capelin feed heavily on *Calanus* north of Iceland. Capelin feeding and subsequent body weights differ between "warm" and "cold" years. In warm years, when North Atlantic water flows north of Iceland, the mean zooplankton biomass is greater, and the mean weight of capelin is also greater. The mechanism for this phenomenon

may be that, in cold years, the Arctic water overlying warm North Atlantic water causes stratification, and prevents the mixing of nutrients into the surface, thus inhibiting the development of a strong phytoplankton bloom, with obvious consequences for the zooplankton.

Dr Wiebe commented on the effects of zooplankton biomass fluctuations on cod populations. In years when phytoplankton blooms and *Calanus* biomass are low, both the weight and growth rate of cod are diminished. Changes in *Calanus* abundance affect larval cod directly, and affect adult cod indirectly via the capelin (because adult cod prey upon capelin). Dr Gislason agreed with this observation, however Dr Sameoto commented that large changes in phytoplankton biomass (satellite observations) appear to have no correlation to zooplankton biomass in the Northwest Atlantic. Dr Gislason observed that, even though we know that capelin clearly feed heavily on *Calanus*, there is no direct correlation between capelin and *Calanus* biomass in the Icelandic time series.

Dr Postel presented results of a time-series of interannual variability in the Baltic Sea. These data appear to support a hypothesis that galactic cosmic rays are the ultimate determinant of variability in phytoplankton, zooplankton and fish dynamics. During the past 40 years, several distinct periods of increases in galactic cosmic radiation appear to be correlated with greater cloud cover, lower insolation, and hence lower phytoplankton productivity, which in turn leads to lower biomass of both total zooplankton and herring. Dr Postel commented that the hypothesis regarding the link to galactic cosmic radiation has both its critics and its supporters.

Summary of Significant Changes

The presentations in this session showed some significant recent changes in the pelagic ecosystems and, in particular, zooplankton populations of both the North Atlantic and North Pacific oceans. Some of these changes are summarized here.

Location	Change in the past decade
NE Pacific (Sta P)	SST increase Zooplankton biomass maximum occurs earlier *Neocalanus plumchrus* biomass maximum occurs earlier Total zooplankton biomass is greater
NE Pacific (Oregon/Wash)	SST increase So. Calif. species common and reproductive thru summer
Scotian Shelf/Grand Banks	SST increase Increase in dinoflagellate abundance Decrease in *Calanus* biomass – order of magnitude Spring bloom occurs earlier in the year (Dec-Jan)
NE Atlantic (Bay of Biscay)	SST increase Increased water column stratification Decreased zooplankton biomass Decreased zooplankton species diversity Mackerel spawning occurs earlier in the year Biogeographical range of some fishes has moved north

3.2 Zooplankton methodology manual and standardisation of methods between ocean basins

TOR b. Discuss and review the published ICES Zooplankton Methodology Manual with PICES colleagues in relation to methods standardisation between ocean basins

Chair: Dr Roger Harris; Rapporteur: Dr Xabier Irigoien

A copy of the recently published ICES Zooplankton Methodology Manual (see annex 3 for details of the book) was presented by R. Harris. After years of effort the objective has been achieved and an extensive manual on zooplankton is available for the scientific community. The book has been published by Academic Press and is available in libraries and upon demand to the editorial (see annex 3 for a copy of the ordering form).

R. Harris signalled that a special deal has been arranged with Academic press where the authors renounced to copyrights but in exchange 150 copies were made available to be freely distributed in libraries of developing countries. Some have already been sent to libraries of scientific institutes in Poland, Latvia, Lithuania and different countries of South America.

All the presents agreed to congratulate Dr Harris on the achievement and expressed their satisfaction with the quality of the manual both as a research tool and as a platform for standardisation. L. Valdés reported the congratulations from the ICES SGQAE for the publication of the Zooplankton Methodology Manual.

Some improvements for a future second edition were suggested: Chapter on behaviour, more effort on gelatinous zooplankton, complete achievement of the part I, part II structure, including a CD with video and images of the different methods.

J. Runge suggested the possibility of creating a web site about the zooplankton manual where people could comment, include revisions and signal mistakes. The comments could be collected and reported yearly to the WGZE so the zooplankton manual has a way to be constantly updated and revitalised.

P. Wiebe and L. Valdés suggested the possibility to link such a web page to the ICES GLOBEC web page maintained by Keith Brander and different participants (Wiebe, Miller, Napp…) indicated the necessity of having a web administrator to control and manage the inputs to the web page. X. Irigoien, with the collaboration of R. Harris, agreed to explore the different possibilities in order to develop the proposed web page.

R. Harris indicated then how useful both the manual and a web site could be for standardisation of the methodology. At this point the discussion was focussed on the standardisation of methods between ocean basins.

T. Ikeda indicated that PICES has arrived at the conclusion that at the present situation intercalibration between the different gears was even more important than standardisation.

P. Wiebe and R. Harris indicated that an effort in this direction has already been conducted in the ICES area with the Seagoing workshop (see discussion in TOR c) and experiments in the Bergen mesocosms. J. Napp explained that a similar idea has been in the air in the PICES area for a year or so and that they were looking for the funds to support it. P. Wiebe explained how the seagoing workshop was conducted without requiring additional funding. Being mainly a problem of coordination it was suggested that a zooplankton working group in the PICES area would help. T. Ikeda and J. Napp explained that in the PICES area the groups have a maximum working time of three years, which limits the achievement of long-term objectives and are mainly focused in concrete problems.

M. Huntley signalled that standardisation, even in the collecting gear, was extremely difficult due to the differences in objectives and target organisms. Ch. Miller also reminded that different research groups already own different equipment and that changing it implied additional costs. Therefore intercalibration appear like a priority.

P. Wiebe signalled that standardisation should be specially important for monitoring programs and that if it is not advisable to change the gear in the already going series as D. Sameoto indicated, standardisation can be achieved with the new ones.

M. Huntley commented that even in monitoring programs the focus can be different. R. Harris noted that even a minimum, such as the units expressing the results could be extremely useful for comparison.

L. Valdés asked about the intercalibration exercise during TASC and A. Gislason explained that only a taxonomic exercise of intercalibration was conducted, not for sampling gear. Ch. Miller indicated that results obtained during TASC from different platforms and therefore requiring different gears have, however, produced very interesting comparative results that are already accepted for publication.

S. Sun commented that for China-GLOBEC the steering committee has made an effort to define or indicate the ideal gear for each situation. That should greatly simplify the comparison of the results. R. Harris indicated that this was a challenge for the working groups that GLOBEC is setting up in the four different regional programs (PICES-GLOBEC, ICES – GLOBEC, SPACC and Southern Ocean). There is also a challenge to make links and comparisons between the different groups.

L. Postel signalled that in the Zooplankton manual there are already comments about the advantages and disadvantages of the different methods, providing guidance about the methods and equipment to use. The Zooplankton Methodology Manual can be used as a working basis to advice on the gears to use.

R. Harris commented that an effort was necessary to standardise the use of new technologies such as the OPC, before each one is using a different method. The possibility of organising a workshop of OPC users was suggested.

To conclude it was agreed that complete standardisation is extremely difficult and that intercalibration must be a priority. However, standardisation must be encouraged in the future and in that sense the ICES Zooplankton Methodology Manual and the web site to be developed were recognised as very useful tools.

The WGZE will recommends to ICES that a site be established on the ICES web page for the purpose of providing a forum for ongoing development and refinements of methods described in the zooplankton methodology manual. Each chapter heading with a brief summary of content would be produced. Members of the research community at a large would have the opportunity to submit comments suggesting improvements to techniques, difficulties in implementations or questions of clarification. The authors would have the opportunities to respond. Submission of new protocols receiving acceptance from the WGZE would also be accepted

3.3 Development of technology and methodology for zooplankton monitoring

TOR d.. *Consider the development of technology and methodology for zooplankton monitoring in both North Pacific and North Atlantic*

Chair: Dr Jeffrey Napp; Rapporteur: Dr Charles Miller.

J. Napp introduced the topic explaining the motivation for monitoring in terms of identifying the "events" which occur in natural and modify marine ecosystems. We are able to recognise these events *because* we have monitoring data through time against which to observe change. Two examples were given:

- The *Emiliania huxleyi* (coccolithophorid) blooms which have appeared suddenly, then recurred for about four years in succession, over the shelf in the eastern Bering Sea. The blooms are visible in satellite imagery. It is the contrast between pictures from before the bloom (CZCS) and pictures during the bloom years (SeaWIFS) which tells us there is a change, that the Bering Sea now is home to a large amplitude production cycle for microflagellates. We have no monitoring stations for zooplankton in the vicinity by which we might evaluate the impact of these blooms. We have no repeated visits to these sites at all by which to examine zooplankton and other responses to the blooms.

- A data record exceeding 20 years for scyphozoan medusa abundance in Bering Sea fishery survey (Pollack, Pacific Cod, etc.) trawls, allows us to see that the very large numbers of *Crysaora meliaster* being caught at present (Brodeur, *et al*. 1999, *Fishery Oceanography*) are an increase of that unharvestable stock amounting to several orders of magnitude. While the cause and significance of this increase are unknown, we do know it is a change because of the long-term data series.

The combined committees agreed in general terms that monitoring series are required so that events such as these can be seen at all and placed into context.

J. Napp characterized current progress toward improving North Pacific monitoring. It includes:

- Initiation of Continuous Plankton Recorder (CPR) lines from Prince William Sound to Los Angeles (A-line) and from Vancouver to the dateline in the Bering Sea (B-line). These samples have been counted for the past year and the initial program runs for two. Drs. David Welch, DFO (Naimo), and Sonia Batten, SAHFOS (Plymouth) are operating the program under seed funding from the Dinkum Sands fund (U.S.). That funding is to support quarterly tows for two years. Dr Welch is working on plans leading to a 50 year series, which he hopes will carry more modern equipment, as well as lasting long enough into the future actually to record effects of climate change.

- US GLOBEC is sponsoring Long Term Observations (LTOP) along cruise tracks seaward from Oregon, Northern California and the coastal Gulf of Alaska. Data include CTD, MOCNESS hauls and oblique tows, all nets analysed for biomass and species abundance.

- Continuing Pacific programs include:

- IOS occupation of Line P (Vancouver Island to 50N, 145W)
- IOS sampling at La Perouse Bank, line SW from Vancouver Island
- The Hawaiian Ocean Time Series (JGOFS)
- Annual occupation of 180W from the Aleutians to the subarctic boundary by Oshoro-Maru of Hokkaido University of Fisheries
- Recurring sampling at Stn. K in the Oyashio
- Acontinuing series of hydrographic and plankton sampling lines radiating from the coastline of Japan
- Annual Walleye Pollack monitoring, with CTD and plankton work, in the Shelikoff Strait and the Bering Sea (U.S. NOAA/NMFS)
- Quarterly CalCOFI sampling in the southern California Current

R. Harris offered a map developed by Dr Chris Reid of SAHFOS showing all identified monitoring programs in the world ocean.

There was general discussion of new technical possibilities for monitoring. The following are under development:

- Several versions of video plankton recorders (VPR). Developments at Woods Hole include a bottom-mounted VPR which rises periodically from its housing to sample, then returns to the bottom, and an autonomous underwater vehicle (AUV) version which potentially could run transects of interest anywhere in the seas. Results can be expected to be rapidly prepared by automated image analysis, which has been developed to a high level under Drs. Gallagher and Davis at WHOI. The machinery will be costly to obtain and maintain, because of its high tech nature. However, it is likely to be inexpensive compared to shipborne surveys. In moored versions time to fouling of lenses will be an issue.

- Optical plankton counters (OPC) have been tried as moored monitoring packages (Bedford Institute). Results to date have been of short duration because fouling problems. OPC's could be ship-of-opportunity instruments, but that has not been established anywhere. Some workers sustain doubts regarding the consistency possible in interpretation of the data.

- Moored pumping systems with Hardy-type recording gauzes have been developed by Dr C. Butman of WHOI. These have mostly been used in short-term deployments for study of meroplankton. However, further technical development could improve both deployment endurance and volume per sample.

Regarding our overall philosophy of monitoring for zooplankton, Dr Mark Huntley offered the following comment (paraphrased here):

> "We need a cost-benefit and general economic analysis of our procedures for zooplankton monitoring. It is very likely we are under-investing in improved technology, thus wasting resources on reliable but expensive and low resolution techniques (e.g., ship surveys with nets). Such an analysis would very likely show that large amounts of simple data (acoustic biomass, OPC results,) would provide benefits because of the potential for high spatial and temporal resolution. While we cannot foresee these benefits exactly, they are likely to be great. We will need to accustom ourselves to some sacrifice of our beloved taxonomic precision to obtain this highly resolved data."

There was considerable, if not unanimous, agreement with that sentiment.

The session on TOR "d" ended without producing strong recommendations or directions for action. If WGZE is to continue to be effective in the area of monitoring technology it must generate specific, explicit recommendations and be prepared to pursue their realization. That would mean approaching national and international funding agencies to support appropriate engineers and scientists to develop needed equipment. WGZE needs to be a partner in these endeavours, sustaining a drive to get equipment developed, then deployed with full support for analysis of the results.

3.4 Operational uses for monitoring activities and environmental indices

TOR e. Continue to develop, with PICES colleagues, operational uses for monitoring activities and environmental indices, in collaboration with fisheries and environmental assessment groups

Chair: Dr Doug Sameoto; Rapporteur: Dr Jeff. A. Runge.

The chair initiated discussion with a description of recent Canadian history of environmental monitoring in relation to fisheries management on Canada's east coast. During the crisis in the cod fishery 8 year ago, management requests for information about changes in the state of the environment, as alternative or contributing explanations for the collapse of the cod stock, could not be met due to the absence of appropriate monitoring of variables associated with planktonic abundance and productivity. Since that time, a zonal monitoring program for the east coast of Canada has been instituted. Management has mandated that environmental and ecosystem information be incorporated into the decision-making process for annual determination of catch quotas for Canadian stocks. At the Bedford Institute of Oceanography, a table of environmental/ecosystem indices describing the state of the Scotian Shelf system has been developed. This one or two page summary provides the fisheries management council with a series of indices (for example, NAO index, surface temp. mean, CPR data on copepod abundance and phytoplankton colour) intended to provide a quick, easily assimilable reflection of environmental state and trends. The table has a column for the present-year status of each index, how it compares to the previous year (up or down) and how it compares to the climatological mean for that particular variable (Annex 4).

P. Wiebe presented the draft announcement of opportunity for the upcoming Phase IV of the U.S. GLOBEC Georges Bank program. One component of the announcement of opportunity is the development of indices to characterise environmental and ecosystem change in this particular system. He pointed out that, during the past 6-7 years of the Georges Bank program, a major environmental event, the Labrador Sea incursion into the region's slope water, has taken place. In 1998, haddock recruitment appears to have been very strong, comparable to strong year classes in the 1960's and 1970's. The egg abundance of haddock in 1998 was similar to previous years, implying that recruitment was the result of better survival of larvae and early juveniles. It is unclear whether variability in planktonic production is also implicated in this process. Goals of the research are to provide: 1) indices of the status of the environment, 2) knowledge of the linkage between environment and recruitment, 3) development of a broad-based understanding of ecosystem – environment systems and ability to characterise it with indices, and 4) identification of the set of processes that influence recruitment.

The question of what to measure besides obvious core variables was put forward. There is a trade-off between what should be measured ideally and what can be measured feasibly and within budget. The probing of coupled physical-biological models of ocean ecosystems (as developed in GLOBEC programs) should provide insight into identification of first order ecosystem variables to measure. The information also should be synthesised in order to provide understandable characterisation of ecosystem state for fisheries and environmental management.

Fisheries/Environment programs using environmental/ecosystem indices include FOCI (Bering Sea and coastal Alaska walleye pollack) and SARP (South African Recruitment Program). In the FOCI program, fuzzy logic is being explored (Dr B. Megrey) as a tool for identification of the most important variables to observe. The status of GOOS was discussed; it was not clear that the measurement of planktonic variables will be adequately measured. GOOS has the potential to gather ecosystem measurements globally. It was pointed out that the OPC has the potential for great value because of its data-collection capacity. The question was posed as to what ICES could do to incorporate more biological indices into the GOOS program.

There was a lengthy discussion about the need for improved technology to enable researchers to sample biological activity with much greater spatial and temporal resolution. This is needed in part for validation of models, but also to simply improve powers of observation, with the expectation that there is still very much we neither know nor understand about the ocean. The need for work to further improve technological sampling was emphasised. What automated instruments could be put on drifters, fixed moorings and automated underwater vehicles? What would be lost in "classical" understanding (e.g. species composition) would be made up by the sheer quantity of spatial temporal measurements which would enable use to document patterns and trends. The OPC, the video plankton recorder and the upgraded version of the CPR were discussed as options. There is also a cost issue involved; there is a need to get the costs of new technology down.

Conclusions to this discussion were:

- Development of environmental indices is important for portrayal of the health of the ocean ecosystem.
- The potential utility for fisheries management should become clearer as time series improve; there is a need for active research on linkage between variation in environment and ecosystem productivity and recruitment.
- Continued technological development and implementation of new instruments with capacity for high resolution data collection is a fundamental next step for monitoring programs.

4 REPORTS ON ON-GOING ACTIVITIES

4.1 Report on progress of results from the 1993 Sea-Going Workshop

TOR c. Report on progress with publication of results from the Sea-going Workshop on Inter-comparison of Sampling Gear and associated data products

Chair: Dr Peter Wiebe: Rapporteur: Dr Doug Sameoto.

Dr Wiebe described his role in the workshop as primarily as an observer of the multi-frequency acoustic data collecting system with the aim of relating these data to net collected data. The Sea-going workshop was held at Storfjorden in Norway for eight days in early June 1993. The objective of sea-going workshop was to compare different zooplankton biomass collecting systems and have a symposium at sea to plan the preparation of the zooplankton sampling manual.

P. Wiebe described the sampling experiments that were carried out from two ships, the Norwegian R/V Johan Hjort and the German R/V A.V. Humbolt. The experiment involved the use of a large variety of zooplankton and micronekton sampling gear by a total of 38 scientists and technicians from eight countries. In addition to the zooplankton data, data were also collected using light meters, CTDs, fluorometers, plus oxygen data were also collected. Conditions in the fiord during the experiment were ideal for this type of experiment, calm and stable for the duration of the experiment.

The acoustic measurements at four frequencies (18, 38, 120 and 200 kHz) indicated a population of mesopelagic fish, *Maurolicus muelleri* present at about 80 m during the day that migrated to near the surface after sunset. Euphausiids were present below the *Maurolicus* during the day, but at night, the euphausiids also migrated to the near surface waters. The major concentrations of small zooplankton (< 2mm) were found in the top 20m, below this depth a low biomass of zooplankton was found.

Samples taken with the WP2 net showed the zooplankton biomass was very stable during the duration of the experiment. The biomass per m^2 of the < 2mm fraction of zooplankton collected with the WP2 and the MOCNESS were very similar. The MOCNESS did collect larger numbers of > 2mm zooplankton than the WP2.

Biomass values in the top 100 m were compared for all types of sampling gear; these values fell into two groups of values, samplers with the largest mesh size collected a lower biomass than did samplers with the finer mesh. It appeared that the most important variable in determining the size of the biomass was the mesh size of the net and not the type of sampler or size of sampler.

A comparison of the MOCNESS and BIONESS in their ability of collect macrozooplankton and micronekton showed that the BIONESS collect more of these animals per unit volume than the MOCNESS, and this was attributed to the faster towing speed of the BIONESS.

A number of papers from this sea-going workshop have been published or are in press.

P. Wiebe has recently acquired most of the zooplankton data and some of the acoustic data. His plans include; (1) creating a log of all the sampling events, but this will take some effort since the original log has been misplaced; (2) finish writing up the results of the sampling experiments; (3) publish the results as a series of papers; (4) create a CD that will include all the data plus a video taken during the experiment showing the operation of many of the samplers along with photographs of the sampling gear.

Questions raised:

Questions were asked if flow measurements were compared in the different gear. The answer was that they were not, but that flow measurements were taken with all the different gear types.

There are more data to be added to the database, such as pump data and large net data that is not available at present.

P. Wiebe plans to complete a paper on the comparisons between different sampling gear, and one on the biology of the fiord. A paper on the relationship between acoustic data and the biology of the fiord will be written that using the forward method of estimating the volume backscattering of the water column.

Dr Wiebe stated he hoped to complete this work by the time of the next WGZE meeting in 2001.

4.2 Status of the WGZE Workshop on Taxonomy of Calanoid Copepods

TOR f. Review plans for a workshop on taxonomy of calanoid copepods

L. Valdés introduced the TOR claiming the concern of this group about the loss of taxonomic expertise within the ICES zooplankton community, which was expressed in the WGZE (1998 and 1999). Based in a proposal presented by Dr Heino Fock in 1999 it was decided to carry out a workshop on zooplankton taxonomy in 2000. The workshop objectives were defined to be:

- Improve and intercalibrate the present taxonomic knowledge among scientist,
- Recommend, strength and initiate further taxonomic research and
- 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 is funded by the German Science Foundation and will be hosted by the Research Institute TERRAMARE (Willhelmshaven, Germany) as courtesy of Dr Gerd Liebezeit, next 14-17 May 2000.

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 in the workshop is still open (2nd call) and those interested are invited to attend (participation is free of charge). Four recognised experts were expressly invited: Ann Bucklin, Penelope Lindeque, Elena Markhseva and Knud Schulz.

The workshop will be focussed on the Calanoida. The first day session will deal with the genetic taxonomy advances and the application of biochemical methods. The following days will be reserved for practical work on Metridinidae, Calanidae, Megacalanidae, Eucalanidae, Aetidae, Paracalanidae, Calocalanidae, Clausocalanidae and Diaptomidae. Open discussions are programmed to discuss difficulties in determination, new systematic, recommended keys, and standards for archiving data and taxonomic information. Experts were also invited to produce and present regional checklists of pelagic copepods.

As an example of the demand and interest on training on zooplankton taxonomy, A. Gislason reported that one of the employees of the MRI had attended a course in zooplankton taxonomy at the Zoological Museum Amsterdam during 1-12 November 1999. The course was organised by The Zoological Museum in Amsterdam in cooperation with ETI Biodiversity Center, University of Amsterdam. It included both practical work, identifying zooplankton, and learning and using the multimedia Linneus-II data management system of ETI. The course was open for marine ecologists, advanced graduate students, and technical personnel, preferably with some basic knowledge in marine zooplankton studies. The number of participants was limited to 12 persons. The course fee was US$ 2300 and included lodging. More training courses like this are already programmed at the Zoological Museum Amsterdam.

In comparison to it, Dr Harris noted that the workshop auspiced by the WGZE is free of charge.

The results of the workshop will be reported to the ICES WGZE. The experience of this workshop will help to improve future activities in this field.

5 PLANS FOR FUTURE ACTIVITIES

5.1 Plans for the EU Enrich Proposal to Further Basin-Wide Synthesis of Datasets collected by TASC, US GLOBEC and Canadian GLOBEC

TOR g. Consider plans for the EU ENRICH proposal to further basin-wide synthesis of datasets collected by TASC, US GLOBEC and Canadian GLOBEC, and how this activity can contribute to the Theme Session on Zooplankton - cod linkages at the 2000 ASC

Roger Harris reported on the initiative of Dr Kurt Tande and himself to submit a proposal to the EU ENRICH programme for a research network, and series of meetings, to continue the basin-wide synthesis of the datasets collected by TASC, US GLOBEC and GLOBEC Canada. While some preliminary work had been done on developing the proposal, due to other pressures it had not been possible to submit for the 15 February 2000 deadline. There was still enthusiasm for the original idea, and a submission might be completed for a future deadline.

Two meetings relevant to trans-Atlantic integration were briefly reported on. Firstly, there will be a Theme Session at the ICES Annual Science Conference, Bruges, 27-30 September 2000 on "Environment - Plankton - Fish Linkages", organised by Ken Drinkwater, Peter Wiebe, Kurt Tande and Jeff Runge. The objective of this Theme Session will be to promote understanding of: (1) the linkages between climate changes and plankton variability and (2) the relative importance of zooplankton fluctuations in controlling changes in fish abundance and production.

Interannual and decadal scale variability in phytoplankton and zooplankton has been the subject of considerable research in recent years within programmes such as GLOBEC and TASC. These programmes have revealed that much of the zooplankton variability occurs in response to changes in ocean climate. Similar connections have been found from analysis of the Continuous Plankton Recorder (CPR) data. The first objective of the Theme Session will be to examine the relationships between climate changes and plankton, with particular emphasis upon establishing the relative importance of climate changes in controlling the large-scale plankton variability, the spatial and temporal scales of the dominant variability, and determination of the underlying mechanisms.

Equally important is to make full use of this information from the fisheries perspective. Therefore, the second objective of the Theme Session is to establish quantitative links between zooplankton, marine resources, and fish. This includes dietary information, such as the main zooplankton species eaten, the relationship between larval condition and survival, and evidence for physical-induced changes in diet.

The second meeting is being organised by the European Commission, a European Conference of Marine Science and Ocean Technology, EurOCEAN 2000, in Hamburg, 29 August-2 September 2000. As part of EurOCEAN2000 there will be a Discussion Meeting with the title, "GLOBEC related studies in the North Atlantic: A perspective for European and North American research co-operation?" This is being organised by Klaus-Guenther Barthel (EU, DG12), together with some help from Dr R. Harris and Dr M. Reeve (NSF). It will be an important occasion to advance issues of future trans-Atlantic research collaboration.

This meeting is intended as a prelude to the possible development of a parallel call for research proposals from both the EU and NSF to mount a basin-wide integrated research programme in the North Atlantic. The Discussion Meeting last for half a day and it is planned that there be a keynote speech and a provocateur's statement, followed by a discussion between the panel and the audience. The overall organisational structure of the session is Chair: Roger Harris, Keynote Speaker: Peter Wiebe, Provocateur: Mark Ohman, Rapporteur: Keith Brander. It is planned to publish the keynote speeches, provocateurs statements and session reports of all sessions in the conference proceedings.

It was agreed in the discussion that both meeting would be interesting, and potentially important in shaping future research directions. All those interested in furthering the prospects of trans-Atlantic collaboration building on TASC were encouraged to attend

5.2 Plans to Develop Data Products and Summaries to the ICES Website

TOR i. Consider, and where feasible, develop data products and summaries that can be provided on a routine basis to the ICES community via the ICES website

Chair: Dr Luis Valdés; Rapporteur. Dr Doug Sameoto.

During the 1999 ICES ASC a general request was made by Dr Bill Turrell (Chair of WGOH) to produce data products for the ICES web site similar to those produced for the Annual ICES Ocean Climate Status Summary report.

It was generally agreed that it was a good idea to try to establish a web site of zooplankton data.

P. Wiebe raised the question as to what products the working group should produce and this resulted in a discussion on who had time series data that could be made available. R. Harris discussed the time series data from his sampling station near Plymouth and showed data on species changes with time and suggested a number of parameters that could be included in the web site products. A summary of data was presented as a data matrix that produced a graphic product when any species data were selected, and this was suggested as a possible web site product.

A variety of web sites were described as examples on how we could format the zooplankton data web site. The Canadian stock status report on the 'State of phytoplankton, zooplankton and krill on the Scotian Shelf in 1998" was presented as the closer example of what the product might look like [for more information please see: www.dfo-mpo.gc.ca/csas, Stock Status Report G3-02 (2000)]

These zooplankton products would have a similar format to the physical data produced by the WGOH. It was suggested that we include summary products from ongoing monitoring sites in the ICES region. L. Postel recommended that we work toward a common monitoring protocol within the different ICES regions. R. Harris reminded us of that collecting monitoring data from the different ICES will be a big job and someone will have to coordinate and be responsible for the collection of data. L. Valdés said he would be willing to try to collect the data from the different regional contacts.

The plan was to keep the procedure as simple as possible for the first year since this was a preliminary year to prove the feasibility of producing a web site with such data. It was requested that members from each of the regions provide at least two graphs of time series zooplankton data to be included in the web site. Data was to be sent to L. Valdés in a spreadsheet such as Excel. It was agreed that the graphs and data presented from different regions be presented in the same format and scale so that comparisons between regions could easily be made. It was agreed to submit data as either or both zooplankton counts or biomass as numbers per m^2. L. Valdés will then produce graphs from these data as time series from the different regions.

In addition information on the contact person in each region, the type of sampling gear, sampling methods used, depth of water in which samples were collected, time of collection, latitude and longitude would be provided as well as the results from the monitoring sites. Links will be provided to the originators' web sites containing the data for each of the monitoring sites and programmes.

SAHFOS will be asked to provide plots of their data of *Calanus* spp. distributions.

The time frame for the completion of the web site with these data will be about 6 months from the end of this meeting. A discussion was held on whether we wanted our own web site and the general consensus was that the Status report provided by the group be attached to the ICES/GLOBEC site which should link up the Ocean Climate web site.

5.3 Plans for a Major ICES/PICES/GLOBEC Comparative Zooplankton Ecology Symposium

TOR k. Organization of a major ICES/PICES/GLOBEC Comparative Zooplankton Ecology Symposium

Chair: Dr Tsutomu Ikeda; Rapporteur. Dr Lutz Postel.

Prior to the meeting, PICES prepared a proposal on a major ICES/PICES/GLOBEC Symposium on Zooplankton Production and Ecology. This PICES proposal included date, venue, definitions and scope, themes and sessions, examples of suggested contributions, and the structure of the steering committee and was distributed in the meeting. Dr Ikeda made a short talk about the background of this initiative, emphasising the need of between North Pacific-North Atlantic comparison on various aspects of zooplankton ecology to deepen our understanding of the lives of zooplankton and their roles and functions in the marine ecosystem under the scenario of global climate change.

The proposal was very welcomed by the group. In fact, the GLOBEC Science Plan is already implemented in the form of regional programmes and research projects in a large number of ICES and PICES countries, and the experts of both communities consider that an ICES/PICES/GLOBEC Symposium is needed to interchange experiences, results, scientific approaches, etc.

Questions concerning the year, the venue, topics and possibly geographical limits for contributions were discussed. The group felt that a symposium in 2002 (original proposal) might compete with other important activities like the Meeting of the World Association of Copepodologists and the field phase of the North Pacific GLOBEC. Consequently, 2003 was considered as the earliest, 2004 would correspond to a decadal interval with the ICES Symposium on "Zooplankton production: measurement and role in Global Ecosystem Dynamics and Biogeochemical Cycles" (Plymouth, 15–19 August 1994).

Considering the fact this last symposium took place in Europe (Plymouth, 1994), an American or Asian venue should be chosen for the ICES/PICES/GLOBEC Symposium, preferably where institutes active in GLOBEC are present. The final decision concerning place and time should be made during the ICES Annual Science Conference (September 2000) after discussing the matter by the GLOBEC Scientific Steering Committee meeting (May 2000). The latter body will inform the chair of the WGZE.

The list of topics proposed by Dr Ikeda included:

- Physical variability and zooplankton population dynamics

- Role of zooplankton in biogeochemical cycles
- Climate influences -- what are long-term data sets telling us?
- Comparative life histories/life cycles of zooplanktonic populations within and between North Atlantic and North Pacific.
- Progress in molecular biology of zooplankton
- The role of microzooplankton in marine ecosystems

With respect to geographical limits for contributions, the group felt that both regionally and globally contributions should be accepted, but depending on the topics there should be some restrictions (e.g. contributions on links between physical and zooplankton dynamics, zooplankton in biogeochemical cycles, long-term variability, and studies on life history/cycles should be focused on the North Atlantic and North Pacific comparisons, but advances in molecular biology of zooplankton and the role of microzooplankton in marine ecosystems should be globally considered).

Then the discussion move to other logistics aspects such as the composition of the Steering/Organising Committee and products and benefits expected from this Symposium. It was proposed that the Steering/Organising Committee be lead by two members from the ICES community, two from the PICES community and two from the international GLOBEC community. These people would be selected by their respective bodies. The Steering Committee would then work with a local organising committee on meeting logistics. The WGZE agreed to the proposed structure of the Steering/Organising Committee without suggesting candidates.

It is expected that the meeting will result in the publication of the best papers in a special issue of an international journal. A journal should be selected soon so that a publication date of the symposium volume can be scheduled by the editors.

R. Harris (international GLOBEC SSC chairman) expressed his support for this proposal, and will bring to the GLOBEC SSC meeting being scheduled in May of this year for discussion. It was considered convenient that the ICES WGZE also approaches the GLOBEC IPO in order to suggest the inclusion of this stimulating ICES/PICES/ GLOBEC Symposium in the agenda of the next GLOBEC SSC meeting (15–17 May, Barcelona) for its discussion and then know the position of the GLOBEC SSC with respect to this initiative (Annex 5).

At the end of discussion, L. Valdés concluded that a recommendation to support the proposal will be made by the WGZE through formal procedure of ICES to be discussed at their annual meeting in September. The results of ICES discussion and resolution should be available to the PICES Science Board for review and discussion at its annual meeting in October.

P.D. Note: After the WGZE meeting, a lot of work was done by e-mail, and a Title for the Symposium, the Conveners, the nominations for the Steering Committee (only PICES and GLOBEC) and the date (approximate) were proposed (see Draft Resolution I).

5.4 Plans for the Joint Session WGPE/WGZE in 2001

TOR h. Prepare for a joint session with wgpe in 2001 on the development of improved understanding of phytoplankton-zooplankton interactions

Chair: Dr Luis Valdés, Rapporteur: Dr Lutz Postel.

L. Valdés introduced the TOR reminded the group that this joint meeting was long demanded by both groups. He also showed a recent letter (12/4/00) received from the chairman of the ICES WGPE, Dr Dave Mills (Annex 6).

The WGPE and WGZE proposed the joint meeting in order to promote studies on phytoplankton-zooplankton interactions. We agree to have a joint meeting for two days, nested (or followed) by two days of separate business at IMR, Bergen, Norway in 2001. We also agree with our colleagues of WGPE that the agenda must be limited to a few topics of discussion. The following were initially suggested:

i) The limits to modelling phytoplankton - zooplankton interactions
ii) Species-species interaction for example in terms of selective grazing
iii) Can a collapse in grazing pressure lead to symptoms of eutrophication?

The three topics were discussed separately and the group recognised that all of them are very ambitious. In fact, the group remarks that each single topic could be the objective of an ICES ASC Theme Session.

The formulation of the first topic was accepted after a brief discussion. Discussion on topic ii took much longer. The group suggests that the stoichiometric aspects of food and consumers should be stressed, as well as the role of the synchronisation within the food web (i.e. the sufficient quality and amount of food at the right time and place). The group also suggests that where possible the topic should be addressed to specific physiological or ecological responses. A possible application of results originates in laboratories or in *in situ* conditions has been found to be of considerable importance in this context. The topic was finally formulated as: How do characteristics of phytoplanktonic diet (size, morphology, physiological condition, and toxicity) influence zooplankton ingestion rates, fecundity, viability, somatic growth and reproduction?

The third aspect proposed above was discussed considering the question in the framework of organisations like OSPAR and JAMP. These scientific bodies are currently debating if zooplankton should be included as an obligatory monitoring parameter or not. The experience of HELCOM, that had supported long-term measurements of food web components, are relevant to this joint session as an important source of information and also to explain how they monitorise the changes in zooplankton communities within the ecosystem. Then the discussion highlighted the demand for cost effective sensors to monitor zooplankton in terms of biomass, abundance and composition. The WG members identified this as a future topic of the WGZE as well as an issue of GOOS.

In conclusion, the group expressed its satisfaction for the proposed joint meeting between WGPE and WGZE which is very welcome and timely. Many of the issues which the WGZE 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. The final formulation of topic was as follows:

- 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 (formulated after discussion of *TOR j*, see point 5.5. in this report)

To guarantee a satisfying outcome, a serious preparation is required. Experts should be invited by the chairmen of the two WGs to review the matter in short. Jeffrey Napp was proposed by the WGZE members to introduce item ii.

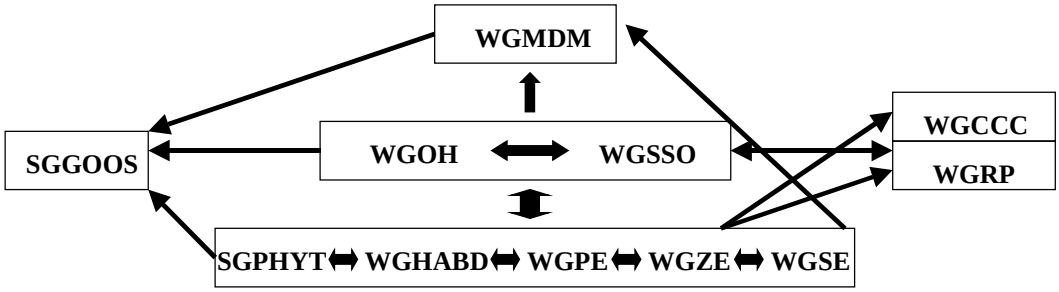
5.5 Plans for the Oceanography Committee's Working Groups Meetings in 2002

TOR j. *Examine the 1999 Oceanography Committee Working Group reports 2000 TORs to identify where inter-group input could be provided or required with the view to formulating key questions requiring inter-disciplinary dialogue during concurrent meetings of the Committee's Working Groups in 2002.*

Chair: Dr Luis Valdés; Rapporteur: Dr Astthor Gislason.

L. Valdés gave the background, saying that in 2002 all working groups under the Oceanography Scientific Committee will meet simultaneously in Copenhagen in April. There will be two kinds of meeting activities: The different working groups will discuss their own specific TORs at separate meetings, while 2 days (approx.) will be allocated for discussing inter-group TORs at a plenary meeting of all working groups.

The group discussed a document from the Chair of the Oceanography Scientific Committee, containing a preliminary sketch of existing relations between the different working groups under the Oceanography Scientific Committee. The group noted that the sketch was incomplete with several missing relationships. P. Wiebe proposed a new diagram on how the different working groups are linked:



There was general consensus in the group on the revised diagram, and P. Wiebe proposed that the organisers of the Copenhagen Meeting should be made aware of it. L. Valdés said that he would present the new diagram to the Chair of the Oceanography Scientific Committee as the opinion of the group. The figure shows that the OCC is composed by two logistic-operative groups (WGMDM, SGGOOS), two cross-disciplinary groups (WGCCC, WGRP) and several disciplinary groups (WGOH, WGSSO..., WGSE). Ideally, key-questions and interdisciplinary dialogue should be addressed to the logistic-operative, the cross disciplinary and the disciplinary groups.

M. Huntley said that the Copenhagen meeting was a good opportunity to meet with members of GOOS. He said that the biological component of GOOS needed to be improved and that the Copenhagen meeting was a good opportunity to have discussions with members of GOOS aiming at improving the biological component of GOOS, especially with respect to zooplankton. P. Wiebe said that the joint meeting with WGPE in Bergen in 2001 should also address this topic. Further, the zooplankton monitoring should also serve as input into GOOS. There was general consensus in the group that at the joint meeting in Bergen the WGZE should discuss with the WGPE ways of improving the phytoplankton and zooplankton components in GOOS.

D. Sameoto said that some measure of diversity should possibly be a part of a monitoring program. Some talk on the use of environmental indices followed, and L. Valdés noted that the environmental indices approach of characterising the environment is very useful for all the groups but it has a special importance for the cross-disciplinary groups, and that the issue should be discussed at the joint meeting in Copenhagen in 2002.

A. Gislason suggested that at the Copenhagen meeting we should discuss with the WGOH if they would post their monitoring data along with ours on the web, so that long-term data on zooplankton could be viewed in the context of hydrography. The discussion on the availability of time series was extended to other disciplines and the group considers that interdisciplinary dialogue would be very helpful in the interpretation of time series of oceanographic data.

To summarise, the group feels that the following topics should be addressed at the proposed inter-disciplinary meeting in Copenhagen in 2002.

a) Biological sampling and operative oceanography. How can the zooplankton be a component of GOOS?
b) Identification of a set of biological indices to characterise the ecological status of the marine environment.
c) What have we learned from the time series programmes? Revision of monitoring activities carried out in the different working groups, and how these may be presented on the web.

6 STATUS OF THE WGZE WITHIN THE OCC: SHOULD WE MERGE NEW WGS OR SGS?

TOR l: Review the objectives and purpose of your WG with the goal of addressing the needs, benefits and disadvantages of merging WGs and forming new ones and justify why your group still should exist.

Chair: Dr Luis Valdés, Rapporteur: Dr Peter Wiebe.

Currently the Working Group on Zooplankton Ecology belongs to the Oceanography Scientific Committee which is now conducting a review of the various Working Groups and Study Groups under its purview. We were asked by Harald Loeng, chairman of the Oceanography Committee, to consider our standing and the rationale for our existence (Annex 7). It was noted that some of the Working Groups are defined by discipline and some are cross-disciplinary. Luis opened the discussion by stating that he thinks the WGZE has reasons to continue to exist because we are producing products useful to the community. Examples given were the Zooplankton Methodology Manual which was just published by Academic Press, the taxonomy workshop which will soon be held in Germany, and the proposed

zooplankton production symposium which is now under consideration. Luis also mentioned the joint meeting next year with the Working Group on Phytoplankton.

The question was then raised as to whether or not we should consider being joined with another Working Group. R. Harris said that he thinks that this group is doing a lot of the work that H. Loeng is thinking that we should be doing. Roger said that he did see some logic in combining the Working Group on Harmful Algal Blooms with the Working Group on Phytoplankton Ecology. And he said it might be logical to join the Working Group on Phytoplankton Ecology with the Working Group on Zooplankton Ecology, but we are doing a lot of interesting work that falls outside of the realm of Phytoplankton Ecology.

M. Huntley said that he was worried about diluting the focus of this Working Group. He said, for example, that he sees benefit in meeting with the Study Group on GOOS, but not merging with it.

J. Napp reviewed the status of groups equivalent to our Working Group in PICES and said they are given a 3-year term of existence. The problem with this, he said, is that three years is often not enough time to solve particular problems or to deal effectively with pressing issues. He thought that things like the development of the Zooplankton Methodology Manual could not have taken place within the structure currently being used by PICES.

L. Postel said he was very happy to have a group that can deal with issue of zooplankton ecology such as standardisation of methods and monitoring activities.

L. Valdés pointed out that although one of the major products, the Methodology Manual, was now out; there was a continued need to work on this topic area.

R. Harris brought up the topic of getting the ICES Zooplankton taxonomy fiche (sheets) more generally available, perhaps through the Web Site that the working group has been talking about creating. L.Valdés suggested that they could also be distributed on CD since the fiche were already in existence and probably only needed to be scanned. There was some discussion about concerns that the fiche might not reflect the current taxonomy of some groups. P. Wiebe said that there was a need to get the fiche out into to the user population and then to figure out what is wrong with the existing fiche and how to fix them.

J. Napp asked what other topics would this working group be concerned with. He thought issues concerning the process and recruitment would be important in addition to those of taxonomy, methodology, and reporting. Both R. Harris and D. Sameoto said that these other topics were very much in our interest. Roger went on to point out that in the field of zooplankton ecology, the Working Group on Zooplankton Ecology was the only group in the world discussing these issues on a regular basis and for this reason, we should keep going as a Working Group.

In summarising, L. Valdés said that he saw the discussion as a positive endorsement for the continuation of the Working Group.

7 ANY OTHER BUSINESS

Comments on the *item h* concerning an ICES SGQAE meeting in 2001

Dr H. Rees in behalf of the ICES/OSPAR Steering Group on Quality Assurance of Biological Measurements Related to Eutrophication Effects (SGQAE) requested advice from the WGZE about the inclusion of zooplankton in the water quality monitoring programs.

A decision on whether to include zooplankton as a parameter and about the methodology to do it will be taken during the SGQAE meeting in 2001 (item h of their agenda “Consider the merits of additional parameters (e.g., zooplankton and primary production) in monitoring eutrophication effects”). SGQAE felt that there is a strong case for the inclusion of zooplankton in OSPAR/ICES eutrophication-related studies because of their potential value as an interpretative aid, e.g. with respect to interactions with phytoplankton populations, and as indicators of environmental degradation. (It was noted that zooplankton studies will be included as a component of monitoring work under the EC 'Water Framework' Directive). However, it was recognised that there would be a need to carefully identify measures appropriate to the robust estimation of changes in populations, e.g., diversity and biomass. As a result, SGQAE recommended that expert advice on the scope for the inclusion of zooplankton studies in monitoring programmes, including consideration of appropriate sampling and analytical measures, is sought from the ICES Working Group on Zooplankton Ecology (WGZE).

WGZE also felt that there is a strong scientific support for the inclusion of a measure of zooplankton in ICES/OSPAR monitoring, because of the sensitivity of the organisms to changes in eutrophication status. WGZE therefore recommends that the ICES SGQAE consider the inclusion of zooplankton structural parameters (abundance and biomass), taxonomic identification and diversity indices (very sensible to environmental perturbations) as routine measurements in eutrophication-related monitoring studies.

Regarding with the methodology to do it, we think that the recently published ICES Zooplankton Methodology Manual offers a good base of discussion, but for implementation purposes an agreement on standardisation and guidelines must be provided by the authorised body (OSPAR, JAMP, ICES SGQAE?). WGZE recognised that, in addition to considerations of the accuracy and precision of a selected method, critical QA aspects include the importance of coupling the process being measured with the timing and spatial scale of sampling effort. Automated measures (e.g. OPC) used in towed bodies may satisfy issues concerning spatial and temporal scales, but at the expense of sacrifice the taxonomic precision.

The WGZE also felt that the experience of HELCOM, that had supported long-term measurements of food web components, are relevant to the questions raised by the ICES SGQAE for both: as an important source of information and also to explain how they monitorise the changes in zooplankton communities within the ecosystem. The Workshop on zooplankton taxonomy auspiced by the WGZE (Wilhelmshaven, May 2000) will produce checklists on the European pelagic copepods, these lists could also be useful for the ICES SGQAE.

China GLOBEC II

Dr Song Sun made two very interesting presentations. Firstly he showed to the group some results of the China research programme in the Antarctic. Secondly he presented the new GLOBEC national programme (China-GLOBEC II), entitled “Ecosystem Dynamics and Sustainable Utilisation of Living Resources in the East China Sea and the Yellow Sea (EYSEC)”. This has been approved as a programme of National Key Basic Research and Development Plan in China, and funded with $4.5 M US dollars for the period of 1999-2004. Nine academic institutions and about 100 scientists are involved in the programme. The major institutions are Yellow Sea Fisheries Research Institute of the Ministry of Agriculture, Second Institute of Oceanography of State Oceanic Administration, Institute of Oceanology of Chinese Academy of Sciences, and Ocean University of Qingdao (Annex 8).

The chairman closed the meeting by thanking all members for their contributions and the stimulating discussions, and Dr Mark Huntley for his excellent organisation. The hospitality of the Director, of the Marine Research Institute at Coconut Island was very much appreciated.

8 ACTIONS, RECOMMENDATIONS AND DRAFT RESOLUTIONS

Actions for the WGZE

Action I

The WGZE will post to the ICES web page a briefing on the publication of the Zooplankton Methodology Manual with a summary of the chapters in a structure that allows the reception of comments suggesting improvements to techniques, difficulties in implementations or questions of clarification.

Justification

The ZMM is a very valuable product of the ICES WGZE. The feed back from experts and users is recognised to be useful for future revisions, for improvements and for inclusion of new methodologies, and in consequence very appreciated. The most interactive way to have access to these comments and suggestions is via the ICES web-site.

Action II

The WGZE will produce annually a Summary status report on the zooplankton monitoring results in the ICES area to be distributed via the ICES web site.

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.

Recommendations to the Oceanography Committee

Recommendation I

The WGZE suggest for consideration of the Oeanography Committee the inclusion of the following items as Terms of Reference for the joint meeting of the ICES WG in 2002:

a) Biological sampling and operative oceanography. How can the zooplankton be a component of GOOS?
b) Identification of a set of biological indices to characterise the ecological status of the marine environment.
c) What have we learned from the time series programmes? Revision of monitoring activities carried out in the different working groups, and how these may be presented on the web.

Justification

These are key questions that require interdisciplinary dialogue, they are addressed to the SGGOOS (kq a), to the cross-disciplinary groups WGCCC and WGRP (kq b) and to the disciplinary groups WGOH, WGSSO, WGPE and WGZE (kq c).

Recommendation II

The WGZE recommends to maintain this group in the Oceanography Committee preserving its actual structure and philosophy as a disciplinary group (which can meet from time to time with other groups with the purpose of solving specific problems), rather than re-structure or merge the group in other WG or SG.

Justification

There is a general agreement within the group that the ICES WGZE have contributed to promote activities of special interest for the zooplanktologists; all of these activities were carried out with success and have contributed to enrich the scientific debate in our discipline. This is seen with satisfaction for the actual WGZE members and we consider that the WGZE should maintain its actual structure in the body of the ICES Oceanography Committee.

Draft resolutions to ICES

Draft Resolution I

The WGZE recommends to support an ICES/PICES/GLOBEC Symposium on Zooplankton Ecology titled “The Role of Zooplankton in Global Ecosystem Dynamics: Comparative studies from World Oceans” to be held during the spring 2003, at a location in Europe to be agreed, with Dr Roger Harris (UK) and Dr Tsutomu Ikeda (Japan) as Conveners.

A Steering/Organising Committee will be established with two members nominated by ICES, two by PICES [Dr Tsutomu Ikeda (Japan) and Dr William Peterson (USA)] and two by GLOBEC [Dr Roger Harris (UK) and Dr Serge Poulet (France)] to assist the local organisers in planning the Symposium. The general Secretary will solicit appropriate co-sponsorship.

Supporting Information

Priority:	ICES is very active in GLOBEC and most ICES member Countries operate national GLOBEC research programmes as well as other research projects for the marine environment where the end products contain valuable information for GLOBEC. PICES also has regional and national interests in GLOBEC. Therefore ICES, PICES and GLOBEC are the most appropriate scientific entities to provide support for such a specific meeting and with respect to ICES the proposal must be considered to have a high priority.
Scientific Justification:	GLOBEC is one of the most well developed IGBP core programmes. GLOBEC is addressed to global key scientific questions and has a high scientific and social relevance. The research strategy includes a strong focus on physical and biological observations. It concentrates in particular on zooplankton population dynamics and responses to physical forcing, and bridges the gap between phytoplankton studies and predator-related research that more closely pertains to fish stock recruitment and exploitation of living marine resources. We are now beginning to compile quantitative documentation on the ecosystem variability and its role in the function of marine ecosystems. This Symposium will lead us into issues related to the role of climate variability and its implications for the dynamics of the marine ecosystems. On the other hand, by the year 2003 GLOBEC will be at its mid-lifetime and a major ICES/PICES/GLOBEC Symposium will be needed to bring together and interchange experiences, results, scientific approaches, etc.
Relation to Strategic Plan:	This Symposium fulfils all the ICES scientific objectives, but especially 1 and 5. It will also serve to enhance communication and coordination with organisations that share ICES' vision and goals such as PICES and GLOBEC, which is an ICES institutional objective.
Resource Requirements:	There will be significant resource requirements, most of which will be met by the imposition of a Conference Fee. ICES is asked to cover the publication of a special issue of the ICES Journal of marine Science.
Participants:	This Symposium will attract a diverse community of scientist from ICES and PICES, but also from other countries interested in GLOBEC.
Secretariat Facilities:	The Secretariat will be involved as normal in general professional and secretariat support, and the Secretariat as usual should provide direct assistance during the Symposium.
Financial:	The attendance of one of two Secretariat staff at the Symposium, in addition to the presence of the General secretary/President will place a significant financial burden on the Secretariat (ca 50,000 DKK)
Linkages to Advisory Committees:	None
Linkages to Other Committees or Groups	GLOBEC embraces a wide range of disciplines and this Symposium could benefit from synergies with other ICES Working Groups such as WGOH, WGSSO, WGPE, WGCCC, WGRP and the ICES/GLOBEC office.
Linkages to Other Organisations:	The Symposium has relevance for the interests of PICES and GLOBEC IPO

Draft Resolution II

The **Working Group on Zooplankton Ecology** [WGZE] (Chair: Dr L. Valdés, Spain) should meet in Bergen, Norway, from 26–29 March 2001 to:

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 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

Supporting Information

Priority:	The activities of this group is 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) The WGZE 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 WGs and Committees (e.g WGCCC, WGRP and ACME). 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 WGZE 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 WGZE. 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 WG in 2002 is an opportunity to discuss topics of common interest. The production of a stimulating agenda is an interactive process among the different WGs. The group has identified three key questions and wishes 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 WGPE and WGZE is very welcome and timely. Many of the issues which the WGZE 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.
Relation to Strategic Plan:	This working groups activities embrace all elements of the scientific objective of understanding the physical, chemical, and biological functioning of marine ecosystems.
Resource	The Working Groups programme encompass the ongoing work of all its members, hence there

Requirements:	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. Last years collaboration with PICES produced a healthy addition to the Groups activities. Such expansions will be exploited whenever possible. It is hoped that the joint meeting with Phytoplankton Ecology will enhance turn out on this occasion.
Secretariat Facilities:	None required
Financial:	None
Linkages to Advisory Committees:	The Group reports to ACME, mainly for the provision of scientific information on Ecosystems
Linkages to Other Committees or Groups	None
Linkages to Other Organisations:	PICES, SCOR and GLOBEC have many activities of very close interest to the activities of this group. Good contact is maintained.

ANNEX 1 LIST OF PARTICIPANTS

Working Group on Zooplankton Ecology

Hawaii, 17–19, April 2000

ICES

Mr Astthor Gislason Marine Research Institute Skulagata 4 PO Box 1390 121 Reykjavik ICELAND Tel: +354 (1)552 0240 Fax: +354 (1)562 3790 e-mail: astthor@hafro.is	Dr Roger Harris Plymouth Marine Laboratory Prospect Place West Hoe Plymouth PL1 3DH UNITED KINGDOM Tel: +44 (0) 1752 633400 Fax: +44 (0) 1752 633101 e-mail: rph@pml.ac.uk
Dr Xabier Irigoien Plymouth Marine Laboratory Prospect Place West Hoe Plymouth PL1 3DH United Kingdom Tel: +44 (0) 1752 633100 Fax: +44 (0) 1752 633101 e-mail:xi@wpo.nerc.ac.uk	Dr Lutz Postel Institute of Baltic Sea Research Seestrasse 15 D 18119 Warnemünde GERMANY Tel: +49 381 5167 206 Fax: +49 381 5197 440 e-mail: lutz.postel@io-warnemuende.de
Dr Jeff Runge I.M.L. C.P. 1000 Mont-Joli, Quebec Canada G5H 3Z4 Tel: +1 418 775 0546 Fax: +1 418 775 0542 e-mail: RungeJ@dfo-mpo.gc.ca	Dr Doug Sameoto Department of Fisheries and Oceans Bedford Institute of Oceanography PO Box 1006 Dartmouth NS B2Y 4A2 CANADA Tel: +1 9 02 426 3272 Fax: +1 902 426 9388 e-mail: SameotoD@mar.dfo-mpo.gc.ca
Dr Luis Valdés Instituto Español De Oceanografía Laboratorio De Santander Po Box 240 39080 Santander SPAIN Tel: +34 942 291060 Fax: +34 42 27 50 72 e-mail: luis.valdes@st.ieo.es	Dr Peter Wiebe Woods Hole Oceanographic Institution M.S. # 33 Woods Hole, MA 02543 USA Tel: 508 28 92 313 Fax:508 45 72 169 e-mail: pwiebe@whoi.edu

PICES

Dr Mark Huntley (USA) The Hawai'i Institute of Marine Biology P.O. Box 1346 Kane'ohe, Hawai'i 96744 Tel + 1 808 325 0779 FAX: (808) 326-9401 e-mail: mhuntley@kona.net	Dr Tsutomu Ikeda (Japan) Biological Oceanography Laboratory Faculty of Fisheries Hokkaido University –1-1 Minato-cho, 3 Hakodate, Hokkaido, Japan. 041-5541 Tel: (81-138) 40-5541 Fax: (81-138) 40-5542 e-mail: tom@pop.fish.hokudai.ac.jp
Prof. Charles B. Miller (U.S.A.) College of Oceanic & Atmospheric Sciences Oregon State University 104 Ocean Admin Bldg Corvallis, OR 97331-5503 USA Tel: (541) 737-4524 Fax: (541) 737-2064 e-mail: cm@OCE.ORST.EDU	Dr Jeffrey Napp (U.S.A.) Alaska Fisheries Science Center National Marine Fisheries Service, NOAA 7600 Sand Point Way NE, Seattle, WA 98115-0070 U.S.A. Tel: (1-206) 526-4148 Fax: (1-206) 526-6723 e-mail: Jeff.Napp@noaa.gov
Dr Song Sun (P.R.China) Institute of Oceanology Chinese Academy of Sciences 7 Nanhai Road, Qingdao China. 266071 Tel: (86-532) 286-8008 Fax: (86-532) 287-0882 e-mail: sunsong@ms.qdio.ac.cn	

ANNEX 2 AGENDA AND PROGRAMME

ICES Working Group on Zooplankton Ecology
Hawaii, 17–19, April 2000

Monday 17 April (East-West Conference Center, Univ. Hawaii Manoa campus)

09:00 – 12:30	**Opening, Agenda, Meeting Programme** **Review and compare the zooplankton ecology of the North Atlantic and North Pacific [Tor a]** (Chair: Ch. Miller, Rapporteur: M. Huntley)
12:30 – 14:00	Lunch
14:00 - 17:00	**Zooplankton Methodology Manual and Standardisation of methods between ocean basins [Tor b]** (Chair: R. Harris, Rapporteur: X. Irigoien) **Report on progress with publication of results from the Sea-going Workshop on Inter-comparison of Sampling Gear and associated data products [Tor c** Wiebe, Rapporteur: D. Sameoto)

Tuesday 18 April (East-West Conference Center, Univ. Hawaii Manoa campus)

09:00 – 12:30	**Operational uses for monitoring activities and environmental indices, in collaboration wi and environmental assessment groups [Tor e]** (Chair: D. Sameoto, Rapporteur: J. Runge) **Consider the development of technology and methodology for zooplankton monitoring in both North Pacific and North Atlantic [Tor d]** (Chair: J.Napp, Rapporteur: Ch
12:30 –14:00	Lunch
14:00 - 17:00	**Review plans for the WGZE workshop on taxonomy of calanoid copepods** [Tor f] (Chair and Rapporteur: L. Valdés) Consider, and where feasible, develop data products and summaries that can be provided on a routine basis to the ICES community via the ICES website [Tor f] (Chair: L. Valdés, Rapporteur, D. Sameoto) **Should the WGZE merge new WG or SG?** (Chair: L. Valdés, Rapporteur: P. Wiebe)

Wednesday 19 April (Hawaii Institute of Marine Biology, Coconut Island)

09:00 – 12:30	**Consider plans for the EU ENRICH proposal to further basin-wide synthesis of datasets collected by TASC, US GLOBEC and Canadian GLOBEC, and how this activity can contribute to the Theme Session on Zooplankton - cod linkages at the 2000 ASC. [Tor g]** (Chair and Rapporteur: R. Harris)
	Organization of a major ICES/PICES/GLOBEC Comparative Zooplankton Ecology Symposium (Chair: T. Ikeda, Rapporteur: L. Postel)
12:30-14:00	Lunch
14:00 -	**Prepare for a joint session with WGPE in 2001 on the development of improved understanding of phytoplankton-zooplankton interactions [Tor h]** (Chair: L. Valdés, Rapporteur: L. Postel)
	Examine the 1999 Oceanography Committee Working Group reports 2000 TORs to identify where inter-group input could be provided or required with the view to formulating key questions requiring inter-disciplinary dialogue during concurrent meetings of the Committee's Working Groups in 2002. [Tor j] (Chair: L. Valdés, Rapporteur: A. Gislason)
	Any other business
	Summary Discussion, Drafting and Completion of Report

Justification:

a) The zooplankton ecosystems of the North Atlantic and North Pacific differ significantly. The best current explanation for the differences concerns the way in which nutrients limit phytoplankton production. There may also be wide-ranging consequences for the rest of the food chain.

b) The ICES Zooplankton Methodology Manual will be in print shortly and the GLOBEC and GOOS programmes have led to increased interest in methodology and standardisation in order to be able to compare between regions and to monitor consistently. A joint approach to these issues by ICES and PICES would be very worthwhile.

c) Results from the ICES Sea-going Workshop on Inter-comparison of Sampling Gear, held in 1993 have not been fully worked up and presented. The work on this item should include a publication about the workshop, collection of all the data generated and production of a CD for distribution, making additional copies of the video of the workshop for working group members, a final technical report on the workshop outcomes and products.

d) As with b, a joint evaluation of methodology and new technology will provide a basis for consistent monitoring.

e) Zooplankton monitoring needs to be designed in order to be able to fulfil operational requirements in relation to fisheries and environmental assessment. These issues have been considered for some time in the North Atlantic and the North Pacific and it is timely to review the conclusions to date and suggest areas requiring further development.

f) The WGZE is concerned about the decline of expertise in zooplankton taxonomy. An EC funded workshop has been planned to take place in to be held in May 2000 in Germany as a first action to try to remedy this.

g) This proposed initiative will be an important means of securing funds for maximising the linkage and interactions between the TASC and USGLOBEC communities, leading to better synthesis of trans-Atlantic data sets.

h) Ecosystem understanding requires increased knowledge of the following aspects of phytoplankton-zooplankton interactions:

- the role of phytoplankton-zooplankton interaction in determining the fate of carbon in nutrient enriched environments
- the limits to modelling phytoplankton - zooplankton interaction
- species - species interaction for example in terms of selective grazing
- can a collapse in grazing pressure lead to symptoms of eutrophication
- the role of physical forcing in determining the fate of phytoplankton carbon

i) and j) were formulated during discussions of WG Chairs at the 1999 ASC

As always with the WGZE, the programme is flexible, and timings may vary. Ample time for discussion is important.

ANNEX 3 ZOOPLANKTON METHODOLOGY MANUAL

PREFACE

Zooplankton are the diverse, delicate and often very beautiful, assemblage of animals that drift the waters of the world's oceans. These microscopic organisms play a key role in the pelagic food web by controlling phytoplankton production and shaping pelagic ecosystems. In addition, because of their critical role as a food source for larval and juvenile fish, the dynamics of zooplankton populations, their reproductive cycles, growth, reproduction and survival rates are all important factors influencing recruitment to fish stocks. It is this latter role which has made zooplankton ecology of particular interest to ICES.

The International Council for the Exploration of the Sea, ICES, is the oldest intergovernmental organization in the world concerned with marine and fisheries science. Since its establishment in Copenhagen in 1902, ICES has been a leading scientific forum for the exchange of information and ideas on the sea and its living resources, and for the promotion and coordination of marine research by scientists within its member countries. Each year, ICES holds more than 100 meetings of its various working groups, study groups, workshops and committees.

Membership has increased from the original eight countries in 1902 to the present 19 countries which come from both sides of the Atlantic and include all European Coastal states except the Mediterranean countries eastward of, and including Italy. ICES established a Study Group on Zooplankton Production in 1992 chaired by Hein Rune Skjoldal, of the Institute of Marine Research, Bergen, Norway. The Study Group were given as terms of reference to:

a) review existing methods for measuring biomass and production processes;
b) make proposals for improvements and standardisation of methods, and prepare a methodological manual;
c) consider the need for a laboratory and seagoing workshop to intercalibrate experimental methods and evaluate new technology.

The Study Group has met eight times, in March 1992 in Bergen; in March 1993 in Las Palmas; in March 1994 in Plymouth; in June 1995 in Woods Hole; in March 1996 in Bergen; in March 1997 in Kiel, May 1998 in Santander, and May 1999 in Reykjavik. In 1997 Roger Harris of the Plymouth Marine Laboratory, United Kingdom, assumed the chairmanship.

The Study Group decided at the first meeting to produce a Zooplankton Methodology Manual recognising the need for improvements and standardisation in methods for studying this important and challenging group of organisms. To assist in the review of methods and to provide input to the issue of standardisation and improvement of methods, three special workshops were convened. The first was a seagoing workshop onboard RV 'Johan Hjort' and RV 'A.V. Humboldt' on zooplankton sampling methods (June 1993). The two others were laboratory workshops at the University of Bergen on production methods using the copepods *Acartia tonsa* (October 1993) and *Calanus finmarchicus* (April 1994). A fourth workshop was arranged by US GLOBEC in Hawaii using marine copepods (April 1994). Results from these workshops have been incorporated by the Study Group in producing this Manual.

ICES changed the status of the Study Group to a Working Group on Zooplankton Ecology (WGZE) in 1994. The Working Group took over the task of completing work with the Manual.

The Scope of the Zooplankton Methodology Manual is to provide an updated review of basic methodology used in studies of zooplankton including recommendations on improvements, harmonisation and standardisation of methods. The chapters aim to maintain a balance between being introductory and comprehensive. They provide an overview of methods that are useful, for example, to graduate students who are starting in a new field. They emphasise the sources of error and the strengths and weaknesses of methods for various purposes and tasks. It has not been possible, however, to go into great detail for all methods, and reference to recent reviews and detailed descriptions of methods is used where possible and appropriate.

Each chapter begins with a review of methods which in most cases is accompanied by recommendations regarding choice and conduct of methods. These reviews consider the background and history of the methodology, the basic principles, sources of variability, equipment and procedures, comparative evaluation of alternative methods, general recommendations, and extensive literature references. Where possible detailed descriptions of standard protocols are included. The aim is to give practical instructions on how to carry out particular measurements and procedures. Equipment, procedures, data analysis and interpretation are described, where possible. These protocols either define standard methods, or give examples of little-known methods. If many methods are used, or many instruments, guidance is given on the most highly recommended, or the most often used, or likely to be used. In some cases it proves difficult

to propose an agreed standard protocol. It is however possible, to provide guidelines that reduce the variability in methods and contribute towards harmonisation and standardisation.

The various chapters of the Manual have been reviewed by the ICES WGZE, and in addition peer reviewers from outside this group have evaluated each chapter independently. Grateful thanks are due to these reviewers for their valuable contribution to the overall project.

Each chapter is authored by an expert, or group of experts, selected from both members of the WGZE and other international specialists. The writing has been organised and co-ordinated by the main author assisted by co-authors. Chapter 1 provides an introduction to zooplankton. Chapters 2, 3, 4 and 5 consider sampling an experimental design, collecting zooplankton, techniques for assessing biomass and abundance, and the specialised methodology required for protozooplankton enumeration and biomass estimation. Chapters 6 and 7 describe new and emerging optical and acoustic techniques for stimulating zooplankton biomass and abundance. In Chapter 8, 9 and 10 methods for measuring zooplankton rate processes are described; feeding growth and reproduction, and metabolism. Chapter 11 gives a modern account of methods for population genetic analysis of zooplankton, and Chapter 12 a comprehensive treatment of modelling zooplankton dynamics.

While striving to be a comprehensive treatment of modern methods in zooplankton ecology, it is inevitable that some topics have not been covered. In particular it was the original intention to include chapters on methods for investigating zooplankton behaviour, and for studying population dynamics. The former chapter was never commissioned, while the latter although originally written as part of the ICES Manual project, was ultimately published as a separate scientific article; Aksnes, et al. 1997. 'Estimation techniques used in studies of copepod population dynamics – a review of underlying assumptions'. Sarsia, 82:279–298. This may still be referred to as being complementary to the work. The original concept of the Zooplankton Methodology Manual included a related CD-ROM to include data, graphics and video images, particularly relating to sampling methods, and deriving from the sea-going workshop. This is not included with the Manual, however the WGZE are still considering the preparation and distribution of such a CD-ROM.

The ICES WGZE has been encouraging and co-ordinating zooplankton monitoring activities in the ICES area, and this Manual should contribute to these activities. Similarly, the development of major international initiatives with a particular focus on zooplankton, particularly the IGBP/SCOR/IOC co-sponsored Global Ocean Ecosystem Dynamics (GLOBEC) project, and the Living Marine Resources module of the Global Ocean Observing System (GOOS-LMR) make the publication of this Manual particularly timely. While not formally adopted by either programme, the ICES Zooplankton Methodology Manual will contribute significantly to the standardisation of methodology that both GLOBEC and GOOS-LMR strongly endorse. The 2000 meeting of the WGZE in Hawaii, with guests from the PICES zooplankton community is a further step in the process of zooplankton methods standardisation between ocean basins.

The preparation of the Zooplankton Methodology Manual has by definition been a team effort. The members of the WGZE and the Editors have lead in this, over the years of development. It is a great pleasure to acknowledge the enthusiasm, dedication and patience of all the authors and co-authors during this process, and the help of the staff of Academic Press during the editing and production of the Manual.

Roger Harris
Plymouth
December 1999

ICES ZOOPLANKTON METHODOLOGY MANUAL

Edited by Roger Harris[1], Peter Wiebe[4], Jürgen Lenz[3], Hein Rune Skjoldal[2], Mark Huntley[5]

[1]Plymouth Marine Laboratory, UK, [2]Institute of Marine Research, Bergen, NORWAY, [3]Institut für Meereskunde an der Universität Kiel, GERMANY, [4]Woods Hole Oceanographic Institution, USA, [5]University of Hawaii, USA

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ANNEX 4 DEVELOPMENT OF ENVIRONMENTAL INDICES

by Doug Sameoto.

The concept of environmental indices evolved from the need to explain changes in the physical and biological environment that occurred when the collapse of the northern cod stocks occurred in the Canadian western Atlantic. The concept of representing changes in various environmental parameters was developed in the early 1990s. The purpose of developing indices was to provide an easily understandable quantifiable measure of environmental change that could be incorporated into the fish stock assessment process. The index of any one parameter should be a simple number that indicates direction of change of the parameter and its relationship to the long-term mean of that parameter. An annual list of these indices was produced for a wide range of physical and biological parameters for different regions on the Canadian Atlantic region. It was believed that over time patterns of change in these indices would be observed indicating the directions in which the environment was moving (i.e. was it warming or getting colder, were phytoplankton levels going up or down etc.). This process is in its initial stages with large numbers of indices being developed. Many of these indices are correlated and with time the numbers of these indices will be reduced to a smaller number that will be easier to work with in the fish assessment process.

The indices for physical parameters are more developed than for biological parameters because time series data for the physical data have been collected for a much long period. As the biological monitoring program continues and collects more data the biological indices will be developed and refined. At this stage, we do not know which of the many indices that we are using will be useful in describing important changes in the environment in relation to fish stocks. This information will only come after a number of years of indices are compared to fish stock changes and it is hoped that relationships between some of the environmental indices and fish population changes will become event.

The following table is a list of physical indices for different regions of the Canadian Atlantic region. There are three columns for each of the indices for each area. The furthest to the right is a comparison of the current year (1999) to the previous five years; the next column is a comparison to the last year. The column listed under 1999 is a list of the standard deviations from the long-term climatological mean. By colour coding the deviations, it is possible to see that the conditions of many of the indices are moving in a similar direction in different regions.

At present the development of environmental indices is at an early stage and indices have not been used in the assessment process. The need to include the environmental conditions in the ecosystem approach to fisheries management will require that effort to produce both physical and biological indices be continued.

Cold/Fresh Conditions	Stn. Devs.	Warm/Salty Conditions
	>2	
	>1.5 to 2	
	>1 to 1.5	
	>0.5 to 1	
	-0.5 to 0.5	

Index	Area	1999	Compared to 1998	Relative to 1994-1998
NAO		1.46	UP	UP
Annual Air Temperatures	Labrador (Cartwright)	1.84	UP	UP
	Newfoundland (St. John's)	3.01	UP	UP
	Gulf St. Lawrence (Magdalen Islands)	3.95	UP	UP
	Scotian Shelf (Sable Island)	3.84	UP	UP
	Gulf of Maine (Boston)	1.18	DOWN	UP
Sea Ice	Lab/Nfld (Area)	-0.95	DOWN	DOWN
	Scotian Shelf (Area)	-1.33	DOWN	DOWN
Near-Bottom Temperatures	Nfld. Grand Bank	2.62	UP	UP
	Station 27	0.78	UP	UP
	St. Pierre Bank	2.08	UP	UP
	Magdalen Sh. Area with T < 0	0.91	DOWN	DOWN
	Magdalen Sh. Area with T < 1	0.30	DOWN	DOWN
	NE Scotian Shelf (Misaine Bank - 100 m)	0.7	UP	UP
	Emerald Basin (250 m)	0.19	UP	DOWN
	Georges Basin (200 m)	1.21	UP	NO TREND
	Bay of Fundy (P5 - 90 m)	1.91	UP	UP
CIL	Nfld Bonavista Bay (Area)	-0.71	DOWN	DOWN
	Gulf St. LawrenceMinimum Temp. (1948-1999)	-0.26	UP	Up
Integrated Temp	Stn 27	0.89	UP	UP
	Cabot Strait (200-300 m)	0.85	UP	UP
	Gulf of St. Lawrence (0-30 m)	0.89	Up	Up
	Gulf of St. Lawrence (30-100 m)	-0.24	Up	Up
	Gulf of St. Lawrence (100-200 m)	0.9	Up	Up
	Gulf of St. Lawrence (200-300 m)	0.49	SAME	NO TREND
Surface Temp	Stn 27	0.96	UP	UP
	Halifax (SST)	-0.01	DOWN	UP
	Bay of Fundy (St. Andrews SST)	2.23	UP	UP
	Gulf of Maine (Boothbay SSTs)	2.73	UP	UP
Salinity	Stn 27	-0.74	DOWN	NO TREND
	Prince 5 (90 m)	1.03	UP	UP

ANNEX 5 LETTER TO DR BARANGE

Dr Manuel Barange
Director GLOBEC IPO
Plymouth (UK)

Santander 3rd May 2000

Dear Dr Barange,

Last 17–19 of April, the ICES and PICES Working Groups on Zooplankton Ecology met together to work on a list of Tors of common interest for both groups. One of these Tors, formulated by our colleagues of PICES, was aimed to plan a major ICES/PICES/GLOBEC comparative zooplankton ecology symposium.

This PICES proposal emphasises the need of a North Pacific-North Atlantic comparison on various aspects of zooplankton ecology to deepen our understanding of the biology of zooplankton and their roles and functions in the marine ecosystem under the scenario of global climate change.

The ICES WGZE expressed their general support for this proposal, and concluded that the WGZE will produce a recommendation to support the proposal and continue through the formal procedure of ICES to discuss this initiative at the Annual Science Conference in September.

The group suggests to form a Steering/Organising Committee based in two members from the ICES community, two from the PICES community and two from the international GLOBEC community. These people would be selected by their respective bodies. The Steering Committee would then work with a local organising committee on meeting logistics. The date was not fixed but the year 2003 was suggested to avoid any competition with other Symposia that are already announced for the year 2002 (e.g. World Association of Copepodologist).

As a first step, it was considered convenient that the ICES WGZE approaches the GLOBEC IPO in order to suggest the inclusion of this stimulating ICES/PICES/ GLOBEC Symposium in the agenda of the next GLOBEC SSC meeting (15–-17 May, Barcelona) for its discussion and then know the position of the GLOBEC SSC with respect to this initiative.

I hope you have a fruitful meeting in Barcelona. Yours sincerely,

Dr Luis Valdés

Chair of the ICES WGZE

ANNEX 6 LETTER FROM D MILLS

ICES WORKING GROUP ON PHYTOPLANKTON ECOLOGY
(letter received April 12th 2000)

Dear Luis

Following our meeting of the WGPE in Rhode Island I want to inform you of the discussion of the Tor from our working group. The TOR was as follows:

prepare for a joint session with WGZE in 2001 on the development of improved understanding of phytoplankton-zooplankton interactions;

The original items for discussion under this TOR were reviewed in Rhode Island and the following 3 items were identified to be taken forward from the original list of 5.

Ecosystem understanding requires increased knowledge of the following aspects of phytoplankton-zooplankton interactions:

i. the limits to modelling phytoplankton - zooplankton interaction

ii. species - species interaction, for example in terms of selective grazing

iii. can a collapse in grazing pressure lead to symptoms of eutrophication?

The WGPE felt that the joint meeting should focus at the level of the organism.

The above does not preclude the WGZE from adding further topics but we should restrict the total number of headings to a manageable number.

Prior to the next meeting it is suggested that individual members of each group agree to prepare material for presentation at the joint meeting and that this is circulated to members of both working groups beforehand to facilitate discussion. Furthermore, WGPE have identified a need to attract a microbial ecologist to participate in the joint meeting.

The proposed place and dates of the meeting are:

Place; IMR, Bergen, Norway

Dates; Week beginning 26th March or Week beginning 23rd April

Local host: Francisco Rey

The WGPE intends to hold its own meeting over two days and proposes that the joint meeting also covers 2 days. In either week it is suggested that Monday is free to allow travelling/recovery of delegates.

I hope you have successful meeting in Hawaii

Best Wishes

Dave Mills

ANNEX 7 LETTER FROM OCC CHAIR

ICES

Oceanography Committee

To:
Chair of Working Groups
Chair of Study Groups
Chair of Steering Groups

13 March 2000

NEW WORKING GROUP STRUCTURE

Dear all,

At the last Annual Science Conference the Oceanography Committee decided different action in order to meet the requirement in the ICES Strategic Plan. The Committee suggested that "the OCC Chair should co-ordinate an inter-sessional review of the objectives and purpose of all WGs with the goal of addressing the needs, benefits and disadvantages of merging WGs and forming new ones". This letter is an attempt to meet this request from OCC, and start the discussion at the forthcoming WG-meetings. Personally, I do not feel that it is a particularly fair question for the working groups. The Oceanography Committee itself needs to be proactive in specifying what it wants in the way of products etc to meet the strategic needs, and it is the committee itself that needs to develop and create the products. However, I think that the Committee needs some input from the working group in order to have a fruitful discussion.

I am not sure if it is the right psychology to even suggest at this stage mergers and dissolutions. Indeed the way ahead may be to encourage evolution within the strategic framework, and other ways of doing things, for example workshops, which have been so successful in the framework of GLOBEC. Could all working groups e.g. work together in preparing/proposing a workshop on *Ocean climate variability*, and also one on *Ecosystem dynamics?* (See explanation below). Workshop on topics of joint challenges between two or more working groups, could indeed be one way to go in order to solve problems that concerns more than one working group.

Parts of the following may be a bit provocative for some of you or your working group members, but my intention is to initiate a discussion, and in that perspective I hope it will work.

For the moment the WGs are mainly discipline orientated, and one idea may be to switch to topic orientated working groups. I 1998 WGSSO suggested two new working groups (this idea was echoed by WGOH):

WG on Ocean Climate Variability with focus on

- monitoring strategies and methods
- dynamics and statistical models
- effects on recruitment, growth and distribution of fish stocks
- operational oceanography

WG on Ecosystem Dynamics including issues like

- process/system studies
- ecological classification quality objectives and measures
- environmental data and knowledge into fish stocks assessment
- ecosystems as unit for management
- transport and fate of contaminants

By presenting this idea originating from WGSSO, I will ask you to consider if topic related working groups will be a better way of handling questions arising from ICES and its clients, or may be as mentioned above, have a workshop on each of the topics. Today, two of the working groups may be considered as partly topic orientated, i.e. WGRP and WGCCC.

Another way is to consider the possibility to change the existing discipline orientated working groups by restructuring and/or merging some of them. Let me use WGHABD and WGPE as an example. IOC and SCOR have jointly established GEOHAB (Global Ecology and Oceanography of Harmful Algal Bloom. GEOHAB is a co-ordinated scientific research to develop international capabilities for assessment, prediction and migration of harmful algae. The scientific goal of GEOHAB is to determine ecological and oceanographic mechanisms underlying the population dynamics of harmful algae, by the integration of biological and ecological studies with chemical and physical oceanography, supported by improved observation systems. Improved Global observations systems will be required to resolve the influences of environmental factors (anthropogenic and climate related) on distribution and trend HAB occurrence. Since this group has been established, do we need WGHABD? A suggestion could be to merge WGHABD and WGPE so they together will take care of problems that are not addressed by GEOHAB. This will probably expand the working area of WGPE (or may be a new name is more appropriate).

Another example is to disband WGSSO. Their work is related to what is done within e.g. WGOH and WGHABD, and one could imagine that these two groups take care of the tasks from WGSSO.

I ask you to review the objectives and purpose of your WG with the goal of addressing the needs, benefits and disadvantages of merging WGs and forming new ones. The result may very well be that the existing structure is exactly the one ICES need. If your WG does not have any objective or remit, could you please prepare one and in addition justify why your group still should exist.

I will collect the input from all WGs in a short report to the ASC in Brugge, and we will then hopefully have a fruitful discussion on the future working group structure under the Oceanography Committee.

On the next page is an illustration on how I believe the present working groups are related. I may very well have overseen some relations, and others may be wrong compared with your opinion. The figure is mainly prepared as a reminder of which working groups that exists, so please, don’t spend your time of discussing details in it.

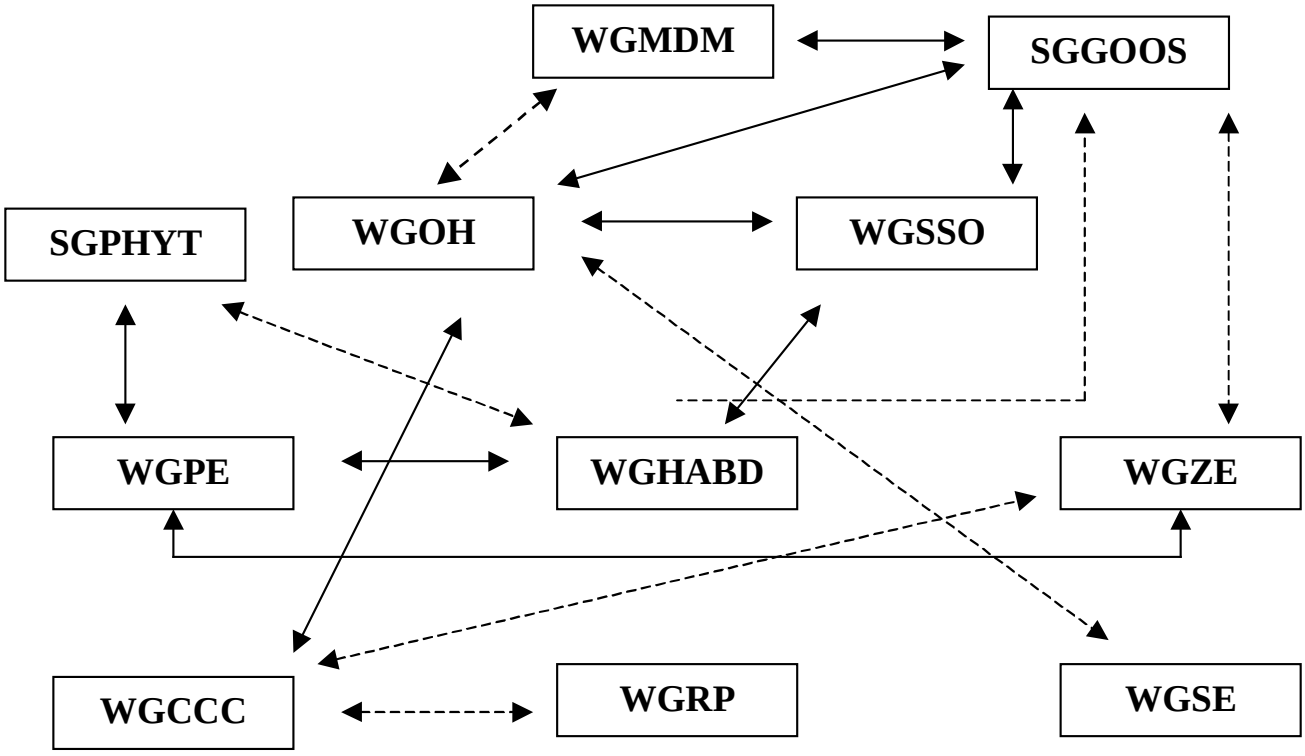
At the end I would like to make an announcement, one that shows the results of hard work. At last ASC Roger Harris told us that the Zooplankton Manual was in press. It is now printed and ready for distribution. My congratulation to WGZE and especially Roger Harris for a very nice job that make both the Committee and ICES proud.

With the best wishes for a successful meeting

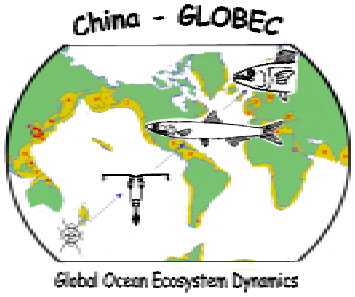
Harald Loeng

A sketch of existing relations between different working groups. Continuous lines indicate a close relation, dotted lines indicate weak relationship.

The figure is not complete, and it is a challenge for the working groups to revise this picture for the future, including new WG-structure.



ANNEX 8 THE NEW AGE OF *CHINA-GLOBEC STUDY*



China-GLOBEC II, entitled "Ecosystem Dynamics and Sustainable Utilization of Living Resources in the East China Sae and the Yellow Sea (EYSEC)", has been approved as a programme of National Key Basic Research and Development Plan in China, with funding of $4.5 M for the period of 1999–2004. Nine academic institutions and about 100 scientists are involved in the programme and the major institutions are Yellow Sea Fisheries Research Institute of the Ministry of Agriculture, Second Institute of Oceanography of State Oceanic Administration, Institute of Oceanology of Chinese Academy of Sciences, and Ocean University of Qingdao.

The programme goals are to

1) identify key processes of ecosystem dynamics, and improve predictive and modelling capabilities in the East China Sea and the Yellow Sea.
2) provide scientific underpinning for the sustainable utilization of the ecosystem and rational management system of fisheries and other marine life.

Because the East China Sea and the Yellow Sea are the research region No.10 and No.9 in the PICES-GLOBEC CCCC, the programme will be regarded as a contribution to providing a regional case for the PICES-GLOBEC and an example of shelf ecosystem dynamics for IGBP/SCOR/IOC-GLOBEC.

The scientific objectives of the programme are to

1) determine the impacts of key physical processes on biological production.
2) determine the cycling and regeneration mechanisms of biogenicelemnet.
3) determine the basic production processes and zooplankton role in the ecosystem.
4) determine the food web trophodynamics and shift in dominant species.

Multiprinciple and comprehensive studies in field work are carried out aiming at the following key scientific questions (KSQs): energy flow and conversion of key resources species, dynamics of key zooplankton population, cycling and regeneration of biogenicelement, ecological effect of key physic processes, pelagic and benthic coupling, microbial loops contribution to main food web.

The programme in the implementation plan has been divided into 12 projects. They are:

1. Characteristics and evolution mechanism of Mesoscale physical processes in high productivity areas.
2. Bottom boundary layer dynamics and its role in setting and resuspension processes in the key regions.
3. Numerical model of ecosystem dynamics in the key regions.
4. Cycling and regeneration of biogenicelements.
5. Interface/boundary flux of the biogenic materials and its transfer mechanism.
6. Processes studies on primary production, secondary production of heterotrophical microbial, and microplankton production.
7. Changes in community structure and biomass of zooplankton and its role in the ecosystems.
8. Population dynamics and productivity of the key zooplankton species (e.g. *Calanus sinacus*).
9. Productivity of benthos and pelagic-benthic coupling processes.
10. Characteristics of trophodynamics and modelling.
11. Dynamics of main resources population and early recruitment mechanisms of key species (e.g. anchovy).
12. Dominant species shifting and important human activities effects on sustainable utilisation of living marine resources.

Chief scientist: Prof. Qisheng Tang
Yellow Sea Fisheries Research Institute (YSFRI)
106 Nanjing Road, Qingdao 266071, P.R.China
Tel: (86-532) 582 3175
Fax: (86-532) 581 1514
E-mail: ysfri@public.qd.sd.cn

Scientific Advisor: Prof. Jilan Su
Second institute of Oceanography, SOA
P.O.Box 1207, Hangzhou 310012, P.R.China
Tel: (86-571) 884 0332
Fax: (86-571) 807 1539
E-mail: sujil@zgb.com.cn