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REPORT OF THE

ICES WORKING GROUP ON ZOOPLANKTON ECOLOGY

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 BACKGROUND AND OPENING OF THE MEETING

The meeting was held at the Marine Research Institute, Reykjavik, from 19–21 at the kind invitation of Olafur Astthorsson and Astthor Gislason. The meeting was opened at 09:30 on Wednesday 19 May, and was attended by 15 scientists from 8 countries.

2 ZOOPLANKTON METHODOLOGY MANUAL

TOR b. Report on the final aspects of publication of the Zooplankton Methodology Manual

Roger Harris presented a brief report on the situation. Since the Santander meeting, an agreement to publish the ICES Zooplankton Methodology Manual had been negotiated with Academic Press. All manuscripts had been completed, peer-reviewed, and revised, with the exception of the Chapter 4, "Biomass and Abundance", which Lutz Postel was still writing. With this exception, the other Chapters were with the Academic Press copy-editor, and the authors would receive technical queries shortly. The group expressed concern that Chapter 4 would be completed to time, as it was pointed out that many deadlines had passed. Roger Harris responded that he agreed, and that the Manual could not be delayed, as an Agreement had been signed with the publishers. If necessary, Chapter 4 would have to be published in shortened form. This would be a pity, and he was working with Lutz Postel, and Jürgen Lenz as responsible editor, to make sure the assignment was completed in full. The publication schedule was for the Manual to be published in October 1999. There was general agreement that this would be a significant outcome for the WGZE, and that after a long history, the publication of the ICES Zooplankton Methodology Manual would do much to advance many of the issues discussed by the WG over the intervening years. It would be a lasting legacy for the group.

3 THE 1993 SEA GOING WORKSHOP: RESULTS AND PLANS FOR PUBLICATION

TOR a. Continue the review of the results of, and plans for publication of, the 1993 Sea-Going Workshop

The discussion was introduced by Peter Weibe and Steve Hay acted as rapporteur.

Peter Wiebe gave a short presentation to remind the WG about what work the sea-going workshop had attempted and achieved. The Sea-going workshop was held at Storfjorden in Norway in June 1993, "on inter-comparison and evaluation of methods for sampling and determination of zooplankton distribution and biomass". Generously hosted by the Norwegians, the workshop involved a wide variety of gears and techniques deployed from two ships, the Johan Hjort and the A.V. Humboldt by plankton scientists from many countries. Peter noted that Hein Rune Skjoldal had produced a video of the seagoing workshop proceedings at the time.

It transpires that there has been a problem with the collation of the data from the workshop since the computer on which a lot of the data was stored in IMR Bergen had broken. Peter Wiebe had collected all the relevant files in his possession onto two CD-ROMs and was going to visit Hein Rune Skjoldal and Tor Knutsen in Bergen after this WGZE meeting to determine and consolidate the position. It was felt that there should eventually be little, if any, data lost but that an effort was required to put things in order again. Once this was achieved then although a preliminary report has been produced (ICES.M. 1993 / L:45) the data and results of this workshop could be made more widely available through more complete evaluation and consolidation into an overview publication. It was noted that there had been a number of publications in the refereed literature which had already incorporated aspects of the gear inter-comparisons made during the sea-going workshop trials.

There was also data held by a number of the attending scientists which had not been collated and an effort must be made to contact these people in order to retrieve these data. In particular Lutz Postel was considered a likely source for the data, particularly the biomass/production measurements, collected aboard the A.V. Humboldt. Steve Coombs (Roger Harris to contact) had data from the LHPR trials and Graham Hays (Sonia Batten to contact) has data on the CPR deployments.

The discussion then considered a number of the inter-comparisons made and noted that a necessary first step in consolidating these data would be to prepare a comprehensive list of the gear comparisons and other work performed. The initial ICES report summarized most of these but not all and would form a foundation. Kurt Tande asked the questions as to who of the participants were available and was funding possible. Peter Wiebe responded by pointing out that any follow-on data worked up would require the active enthusiasm of those holding results and that Hein Rune Skjoldal was in the best position to assess further requirements for data analysis. Peter also said that he had already processed most of the acoustic and some of the biomass data. Doug Sameoto noted that there were particular problems in relating net-derived standing stock estimates for depth layers to concurrent acoustic data and there followed some

discussion of the acoustic transducers used on the sea-going workshop and their appropriateness for plankton abundance estimation. It was noted that the comparison of CPR data with that collected in the same watermass by other nets would be most helpful, since this was a major area of criticism of the CPR data, which had not yet been fully addressed in the literature. Even if there were not simultaneous tows, the Storfjorden area probably contained a fairly homogenous plankton community over the period of the workshop so valid catch comparisons could probably still be made.

There ensued some discussion of the problems expected and experienced in gear inter-comparisons, including mesh size differences and difficulties in the use of flowmeter measurements used to estimate volumes filtered by nets. Keith Brander reminded the group of recent detailed work on flow measurement problems. It was suggested that a general overview of the work area including an account of the species distributions and abundances found, would provide a basis for simple discussion of sampling issues. This should highlight questions of gear choices, mesh selection and avoidance problems. The basis for choice of gears and methods as well as sampling strategies should include target species groups and awareness of the limitations of different gears.

After lunch the session reconvened, Peter Wiebe reviewed discussion to date and after a little further discussion the group concluded the session with the following conclusions.

Conclusions:

1) A scientific paper should be developed to describe the Sea-going Workshop, the estimates of distribution and biomass of the plankton in the area surveyed and the issues surrounding the gears and methods deployed.

2) There should be a collection of all the available data generated during the workshop and this should be archived onto a CD-ROM to be made generally available.

3) Additional copies should be made of the video produced by IMR Bergen at the workshop and these should be widely distributed, and certainly to the active members of the WGZE.

4) A final technical report should be produced which would describe the workshop outcomes and products, along with any conclusions, suggestions or advice.

4 STATUS OF ZOOPLANKTON STOCKS IN THE ICES AREA: ZOOPLANKTON MONITORING (NORTH ATLANTIC REGIONAL GOOS).

TOR c. Report on the status of zooplankton stocks in the ICES area, and consider plans for a co-ordinated zooplankton monitoring programme based on national programmes as a contribution to a North Atlantic regional GOOS

The discussion was introduced by Keith Brander and Sonia Batten acted as rapporteur.

Roger Harris summarised the previous activities of the group and then Keith Brander described the current GOOS situation. A main objective of GOOS is to address the current lack of understanding of oceanic systems because of undersampling. GOOS now has considerable political support with many governments stating an intention to support GOOS. The ICES GOOS steering group met just prior to the ICES WGZE and although the full report was not yet available some recommendations could be outlined. A key issue is global warming and the role of the oceans in sequestering carbon. Sustainable harvesting and the marine ecosystem itself are other issues. GOOS has a Living Marine Resources Panel and there is also EUROGOOS. Keith Brander informed the group that ICES has a close involvement and now that GOOS is becoming operational it is a key moment to make the case for routine monitoring activities to be included. There are three main components to the ICES involvement;

- The ICES oceanography database
- Routine fish stock monitoring
- The intended International Bottom Trawl Survey

The WGZE component should also be included and Keith Brander outlined some correspondence he had received which supported the ICES collaboration. In essence, GOOS is an operational programme which requires regional co-operation in quality assurance and data logging and contemporaneous measurements of the biological, physical and chemical environment. The WGZE monitoring activities fit these criteria, and one of the group's recommendations should be that this is an ICES contribution to GOOS.

This promoted a discussion on the nature of zooplankton monitoring and which elements are most appropriate for GOOS, whether research or operational monitoring. At present biological monitoring lags behind physical monitoring, however, this situation is continually evolving. Steve Hay suggested that the activities should be defined in terms of the products, i.e the output is the key deliverable, not necessarily the methodology used to derive it. Keith Brander pointed out that this approach necessitates extensive metadata to describe how the measurements were made but that this was an unavoidable activity. It was felt that the group needs to state its position on methodologies as it is unable to recommend a particular method.

The group also discussed the relationship between GOOS and GLOBEC and it was stressed that GLOBEC has a shorter, finite, duration and is regarded as developing tools which could then be implemented within GOOS. Olafur Astthorsson queried whether or not the group would contribute to a common database and Keith Brander outlined ICES position by stating that so long as the capability to provide links exists the physical location of the data is unimportant. ICES plays a large role in quality assurance and there is a dialogue between ICES and the data originator. If national agencies could carry this out it would be a help but there are some model examples which exist and which could be followed, e.g., the Baltic monitoring.

The group could also contribute to another facet of GOOS once the Zooplankton Methodology Manual is published as this can be seen as an example of capacity building.

Sonia Batten reported that the SAHFOS Council had discussed how contributions to the CPR funding could be viewed as a government's contribution to GOOS. Doug Sameoto pointed out that Canadian monitoring was viewed in the same way, and the group agreed that this approach shifts the emphasis from short to long-term support of monitoring activities.

Luis Valdés questioned whether the inclusion of zooplankton monitoring within GOOS was valid as GOOS seemed to be more concerned with commercially relevant data and quasi real-time measurements, which is not possible with current zooplankton monitoring. He suggested that ICES should try to find the common themes between the multi-layers of GLOBEC and GOOS since the parties won't be changing their monitoring to fit the programs because programs change. Keith Brander responded by saying that ICES can facilitate the activities by acting as an umbrella organisation and he drew the group's attention to a planned mini-symposium at the forthcoming Annual Science Conference which will address precisely these issues. It was hoped that group members would raise these points at the symposium. There was some debate as to whether rate processes were more important than state variables, as suggested in the Canadian GLOBEC contribution to the ICES/GLOBEC newsletter, however, it was felt that examples demonstrating either case existed. The group at present mostly measures state variables though some rates, such as primary production and egg production, are measured.

Roger Harris outlined the broad approach apparent at the recent GOOS LMR panel meeting in Montpellier, March 1999. It was felt that the group's ability for semi-automated zooplankton monitoring looked more likely to succeed than other proposed monitoring. He reiterated that the GOOS LMR panel is looking to GLOBEC to provide a testing ground.

There was a brief discussion on whether or not biodiversity was an issue within GOOS and how ecosystem changes should be dealt with. Roger Harris reported that the LMR panel had extensively discussed biodiversity at its meeting. Steve Hay pointed out that it is not just physical parameters that will indicate global change. Species and population changes are also indicators and perhaps the group should address which parameters should be measured and not just the output of the monitoring. Luis Valdés said that motivation is required to maintain monitoring beyond about ten years and that we need to be able to combine time series to increase their value. Steve Hay reported that the Aberdeen monitoring will now include estimates of *Calanus* over-wintering and Olafur Astthorsson described how Icelandic monitoring is both coastal and oceanic. Peter Wiebe reported that the USA was encouraged to look beyond GLOBEC because it was recognised that the Gulf of Maine ecosystems were important. Future monitoring may be very different in terms of technology and sampling strategy with one possibility being the instrumenting of fishing boats, in a meteorological rather than biological sense, with onboard telemetry. Assimilative models require 'feeding' which will give an impetus to monitoring because zooplankton are important for ecosystem models. Assimilative ecosystem modelling will appear in the future although at present we are not in a position to identify the precise data needs. The group discussed whether or not this would drive changes in monitoring or simply require added components before concluding that this may be a premature discussion.

Keith Brander concluded the background discussions by outlining a series of conclusions.

Conclusions:

1) ICES member states should be invited to designate existing regular, routine zooplankton monitoring activities as ICES GOOS components

2) The designated monitoring should be submitted to ICES within an agreed time

3) The ICES Secretariat maintains a list of designated monitoring activities, monitors submission performance and produce summary data products

4) The Working Group should continue to develop the technology and methodology for zooplankton monitoring and should work closely with monitoring programmes being developed in physical, chemical and biological oceanography

5) The Working Group should continue to develop operational uses for the monitoring activities, in collaboration with fisheries and environmental assessment groups.

6) The WGZE has reviewed and tabulated information on national zooplankton monitoring for several years. Some of the surveys and sections on which these zooplankton data are collected are already part of the ICES GOOS programme for oceanographic data.

7) Designation need not involve any change in the existing routine monitoring and may include only some of the data being collected. It requires a commitment to continue with the monitoring and to make the results available in a timely way.

8) Some of the current monitoring data are been used operationally, but much of it is not, because the time series are short and the operational applications (to issues in fisheries assessment, ecosystem monitoring and effects of anthropogenic factors) are still being developed. The monitoring activity is therefore partly operational and partly research at this stage.

9) There is considerable scope for developing the technology and methodology of zooplankton monitoring and this should be an explicit aim. This will require further refinement of the objectives (especially in relation to operational applications) and co-ordination with developments in modelling and observation of the physical, chemical and biological components, which are relevant to zooplankton. Since work of this kind falls within the aim to the GLOBEC programme, full use should be made of the opportunities for funding and international co-ordination, which GLOBEC currently offers.

10) The question of intellectual property and acknowledgement of sources should be considered carefully in relation to data supplied from the zooplankton monitoring programme. The issues are probably not different from those raised by monitoring of other biological oceanographic data.

Review and update of monitoring activities

Individual reports are included as Annexes and are briefly summarized here.

Canada

Doug Sameoto reported that the CPR support is a major component of Canadian monitoring. He described the length and location of the time series and presented some recent results which show a change in the ratio of diatoms to dinoflagellates and a significant decrease in the numbers of juvenile *Calanus finmarchicus* which has also been seen in net samples. There have also been changes in the timing as well as the magnitude of the spring increase in phytoplankton.

USA Georges Bank

Peter Wiebe described recent findings in the Georges Bank monitoring which has seen a decline in salinities in the first six months of the year since 1995 and a general 20 year decline. Local forcing is thought to be more important than advective processes. Oxygen isotope measurements have helped to detect the fresh water sources and it is believed that the proportion of Gulf of Maine water, relative to shelf water, has been increasing. Fluorescence changes have been

noted, and this is attributed to a change in species because chlorophyll levels have not changed. Haddock show some signs of improved numbers of eggs and larvae and zooplankton volume and the NAO show a good relationship.

Portugal

Emilia Cunha outlined the monitoring taking place at four sections along the coast, which is principally for fish larvae but some zooplankton work is done at each. The zooplankton biomass has shown a decrease on the northern Portuguese coast with a corresponding increase in temperature.

This programme may receive more support if certain zooplankton monitoring activities were to be designated by the WGZE.

Germany, Helgoland Roads

Heino Fock detailed recent results from the Helgoland Roads time series which includes a discernible change in abundance of two groups of species. Coincident wind strength changes and the effects on turbulence were proposed as a mechanism.

UK, Aberdeen

Steve Hay reported that there was a more positive attitude to monitoring developing and a single station just south of Aberdeen has been established which has been sampled weekly for the last two years. Results will shortly be available on the web-site. It is intended that the hydrographic survey lines also include multi-depth zooplankton sampling to determine the overwintering of *Calanus* and couple this to hydrodynamic models to predict the influx of the copepod. This monitoring is also relevant to oil spill incidents, to establish a base-line.

Russia

Kurt Tande reported that the Russian time series of approximately 30 years was stopped in 1994. TASC has obtained some of these data which will be presented at the TASC meeting in Tromsø in August 1999.

Norway

Kurt Tande said that Norway does not have a sophisticated monitoring program but that Tromsø is trying to implement an OPC approach. Four transects were sampled last year with two so far this year. At present this is a research approach and it is not clear if it will become a routine system (Further information on the IMR, Bergen, activities, was received during the course of the meeting).

Canary Islands

Santiago Hernández León described the zooplankton work undertaken around the Canaries. Sampling is not continuous, however, they are constructing a database of all zooplankton biomass data collected. There were over 100 cruises between 1972 and 1978 for example, and when the data search is complete there should be 30 years of data.

Spain

Luis Valdéz reported on the location and duration of the Bay of Biscay sampling. They have adopted a standardised approach so that every participant follows the same procedure and stores the data promptly. He gave a short summary of the Bay of Biscay project which has described an increase in temperatures, particularly in winter, which may affect stratification and shows a good correlation with sardine recruitment, presumably through food supply.

Iceland

Olafur Astthorsson described the Icelandic monitoring. Plankton data are collected once per year, in spring, from 100 stations around Iceland. There is also some work in the Norwegian Sea, in collaboration with Norwegians over the last four years where hydrography, plankton and herring data have been collected. This oceanic time series is developing and it is hoped that it will continue into the future.

5 ENVIRONMENTAL INDICES INVOLVING ZOOPLANKTON POPULATIONS

TOR d. Consider the development and application of environmental indices involving zooplankton populations, and the standardisation of products from zooplankton monitoring data

The discussion was introduced by Doug Sameoto and Olafur Astthorsson. William Silvert acted as Rapporteur.

Introduction: Consider the development and application of environmental indices involving zooplankton populations

Doug Sameoto gave the background, saying that the Cod Crisis had raised questions for which physical oceanographers could provide input, but the biologists could not. The idea developed to create plankton indices analogous to forest fire indices. The problem was, how do you decide if index is good or bad or neutral? This depends on the stock you are discussing. What is good for one stock can be bad for another.

He reported on the work he had been doing with Glen Harrison on preparing a State of the Plankton (Phytoplankton, Zooplankton and Krill) report analogous to State of the Ocean report prepared by physical oceanographers. This could be useful to fishing industry. Physical indices include surface and bottom temp, salinity, O_2 levels, nutrients. Physical indices – cold intermediate layer is critical and is measured. Glen Harrison is looking at a stratification index.

A phytoplankton index is difficult, as there is no long-term data set, so CPR greenness and SEA-WIFS satellite data are being investigated. The idea is to see if primary productivity is increasing or decreasing. A chlorophyll index will probably be used next year, a primary productivity index will be harder to develop. It is not practical to consider all species, but a few dominant species are being investigated.

A zooplankton biomass index is based on dry weight biomass, but it will probably not be used for a long-term index. The CPR is the backbone of the program, considering total copepods, *Calanus*, krill, and the colour index. OPC gives more technical information, but it isn't funded for monitoring, so the use of OPC is still tentative. Bloom monitoring can also feed into environmental indices.

Indices are very client-specific. Their presentation needs to be simple and understandable. At present the information is available, but is not being fully used.

It was questioned whether clients participated in the planning process and design of indices, and how is this being integrated with fisheries management? At present there is little integration, stock assessment scientists have shown little interest to date.

Keith Brander commented that changes may be more significant than current values. However, given very limited budgets and ship time, it is difficult to monitor changes. We should base these indices on models of how oceanographic conditions evolve under different types of oceanographic forcing.

There was discussion of the importance of integrating physical and biological forcing in a framework that has a sound theoretical basis. There was some talk about how this ties in with more long-term research on ecosystem productivity and functioning. Fisheries science is moving in the direction of multi-year assessment and sustainability.

Further discussion centred on changed attitudes in the fisheries science community towards system dynamics, essential fish habitat (including zooplankton), and whether we should be looking for more sophisticated indices, or better packaging of the material which we currently have. Keith Brander raised the example of CPR data showing 60 years of good correlation between zooplankton and herring catches without identifying which factor is causative and thus what the linkage is. Bill Silvert responded that we should still be providing information on factors like zooplankton biomass, on the grounds that if we don't start providing information that is at least potentially meaningful, we won't be able to set up communication with these client groups.

The role of gelatinous zooplankton was raised, and there was agreement that they are not adequately sampled. This led to a further divergence on the question of whether we should be developing simple indices based on current monitoring practices for immediate use, or whether more research was needed to develop a clearer picture of the role of zooplankton in ecosystem functioning in order to develop more meaningful indices. However there did not appear to be any real disagreement that both approaches are necessary.

Guest presentation on the use of Fuzzy Logic

After lunch, Bill Silvert gave a guest presentation on the use of Fuzzy Logic for the development of ecological indices. There was considerable discussion, and the main points were:

- There was concern about the acceptability of fuzzy indices vis à vis numerical measures.

- Steve Hay was concerned that Fuzzy Logic was so complicated that users could not describe results in understandable terms, in comparison with statistical analysis that is straightforward and implemented with standard statistical packages. Silvert replied that Fuzzy Logic is basically simple, even though some of the calculations of weighted sums are tricky, and is no more arcane than most statistical procedures. He also commented that many of the popular statistical procedures are inappropriate, for example they are based on a linear model of nonlinear processes.

- Peter Wiebe asked about the connection between Silvert's presentation and the kind of fuzzy control theory used to control elevators, etc. After some discussion it was suggested that one could use a stock classification like "healthy", "low", "endangered", possibly in combination with terms like "increasing" and "decreasing", to represent stocks in a way that would facilitate a similar control theory approach to fisheries management.

- Keith Brander raised questions about how fuzzy classifications could be incorporated into stock assessment, given that inputs are weighted according to variance and fuzzy classes seem to have large variance. It was felt that Fuzzy Logic might be more appropriate for long-term prognoses than for annual stock assessment.

Standardisation of products from zooplankton monitoring data

The final discussion dealt with standardisation of sampling. There seem to be wide differences in the protocols that are used for collecting and processing zooplankton data, such as wet vs. dry weight, density per m^2 vs. m^3, as well as differences in mesh size and fractionation. It was clear that there are serious difficulties in agreeing on a standard set of protocols, but there did not seem to be any easy resolution of the issue, though the imminent publication of the Zooplankton Methodology Manual was a practical development.

6 INVENTORY OF ZOOPLANKTON TAXONOMISTS: TAXONOMY WORKSHOP

TOR f. Review an inventory, compiled intersessionally, of zooplankton taxonomists for the major taxa and prepare plans for a workshop on zooplankton taxonomy

The discussion was introduced by Luis Valdes and Emilia Cunha. Heino Fock acted as rapporteur.

Concern had been expressed at the last meeting of the WGZE about the loss of taxonomic expertise within the ICES zooplankton community; development of an inventory of zooplankton taxonomists will be a step towards addressing this problem. The recommendation concerning the proposed workshop stems from discussion at ACME (ICES Advisory Committee on Marine Environment).

Luis Valdés gave the introductory presentation. At the 1998 meeting of the Working Group on Zooplankton Ecology in Santander, Spain, it was concluded that the WGZE should consider a number of issues. These were briefly reviewed.

Luis Valdés presented a checklist of calanoid copepods for the Ibero-Atlantic waters and the Bay of Biscay (ANNEX 4). Further checklists are to be set up during the taxonomic workshop (see below). The suggested list of areas comprises: the Baltic Sea, the Kattegat and Skagerrak, the regions of the North Sea, the waters around the British Isles, the Bay of Biscay, Iberian-Atlantic waters, Icelandic waters, St. Lawrence Estuary, Canadian Atlantic waters, north-east USA waters, south-east USA waters. To some extent these activities are paralleled by European MAST-projects such as 'The European Register of Marine Species' which is a research consortium funded by the European Union under the MAST (Marine Science and Technology) programme producing: i) a register of marine species in Europe, ii) a bibliography of identification guides, iii) a register of identification experts and iv) a list of collections of reference specimens (see http://erms.biol.soton.ac.uk).

Based on contributions from Jürgen Lenz (letter to R. Harris), E. Cunha, L. Valdés, H. Fock and S. Hernandéz-León and a presentation by Santiago Hernandéz-León on taxonomic activities in the Canary Islands (Annex 7) a preliminary list of taxonomic experts was compiled. Corrections and further completing will be achieved during the taxonomic

workshop and by giving notice to the rapporteur. K. Tande mentioned that a lot of expertise for the northern seas is available from Russian taxonomists who should be also contacted. Further information on taxonomic expertise will be probably available from the ETI (Expert Centre for Taxonomic Identification, The Netherlands), and the Smithsonian Institute (U.S.A.).

Based on a proposal presented by Heino Fock it was decided to carry out a first workshop on zooplankton taxonomy as a start of a series of related activities. This first workshop will deal with the taxonomy of calanoid copepods and is to be held in Wilhelmshaven, Germany, 14/15–17 May 2000. It is intended to invite 5–6 experts and about 20 participants. Luis Valdés, Steve Hay and Heino Fock serve as organisers and will prepare invitations to the course in due time. It was agreed to also invite experts on genetic and biochemical methods for copepod taxonomy. The purpose of the workshop will be:

- to upgrade taxonomical information.
- to broaden expertise among participants.
- to present, exchange and compare taxonomic material from adjacent seas.
- to discuss the identification of species and characteristic features probably not included in identification sheets.
- to evaluate the inventory of available ICES-sheets and probably recommend the compilation of new sheets.
- to define standards for determination and classification, for minimum size of determination for problematic species, for separating between juvenile and adult specimens, for size classes, in order to deliver comparable data products.
- to prepare regional species checklists.

The results of the Work Shop will be presented to the WGZE by means of a report.

Roger Harris suggested that it would enhance availability of the ICES-zooplankton sheets to have them published on the world-wide-web. This topic will be pursued by the workshop organisers in co-operation with the present editor, A. Lindley, and ICES HQ.

Conclusions:

1) The WGZE is concerned about the loss of expertise in some fields of taxonomy related to zooplankton research.

2) Therefore the WGZE has decided to consider and support activities that increase taxonomic skill in zooplankton research by means of organising workshops, preparing taxonomical checklists as well as lists of taxonomic experts and to make them publicly accessible.

3) As a first action it was decided to conduct a workshop on the taxonomy of calanoid copepods to be held in May 2000 in Germany.

4) To create a checklist of the zooplankton species belonging to the different communities within the ICES area.

5) To produce a list of the "approved" zooplankton taxonomist within the ICES area,

6) To have the information on the ICES Zooplankton Identification Sheets on a CD-ROM that would be available to the scientific community,

7) To create a data base that would contain information on "old samples".

8) To create a mailing list of the zooplankton ecologists within the ICES area.

9) The WGZE recommends that these activities should be continued.

7 PLANS FOR TRANS-ATLANTIC CO-ORDINATED RESEARCH ACTIVITIES (GLOBEC)

TOR e. Consider plans for trans-Atlantic co-ordinated research activities in the context of GLOBEC

This discussion was introduced by Peter Wiebe and Kurt Tande. Keith Brander acted as Rapporteur.

Keith Brander introduced this topic and referred to the international workshop on North Atlantic Climate Impacts, which took place in Reykjavik in September 1998:

(http://www.rannis.is/english/news-adv/naci/index.html)

The purpose of the workshop, which was sponsored by the Icelandic Research Council, the NSF and DG XII of the EU, was to identify important research tasks for future cross-Atlantic co-operation. The scope of the issues was much wider than zooplankton and GLOBEC and in particular it included physical and climatic variability. A proposal for a Grand Challenge was presented at the workshop by Peter Wiebe (see below).

Peter Wiebe viewed the "Challenge" as phase IV of the current US GLOBEC program on Georges Bank, together with a further synthesis stage of TASC, but there would also be further broad scale fieldwork.

Olafur Astthorsson noted that he had also contributed a section for the RANNIS report, but it may not have been included. He drew attention to the Mini-Symposium at the forthcoming ICES ASC, which will provide a venue for further discussion and planning of joint programmes.. Keith Brander urged that particular attention should be devoted to bringing out the links between further work and *Calanus* and fisheries variability, since that is one of the major

A Grand Challenge

Building upon the progress and results of GLOBEC, TASC, and Mare Cognitum, a Grand Challenge is to create a collaborative program of physicists, biologists and modellers to build and test a coupled physical/biological model that can effectively caricature the space and time variation of a broadly distributed and dominant member to the North Atlantic zooplankton community, *Calanus finmarchicus.*

Such a model, developed for a single species for the entire North Atlantic basin would pave the way for the development of models for other species and more elaborate models for the ecosystem as a whole. An ocean-basin scale analysis through observation and modelling should lead to a fundamentally new understanding of ecosystem dynamics and allow prediction of responses to climatic variation.

justifications for carrying out programmes such as TASC. It is not enough simply to say that *Calanus* is an important part of the trophic system on which fish depend. Peter Wiebe mentioned studies which try to relate the timing of the spring ascent of *Calanus* to the primary production cycle and to feeding by early stage cod larvae. This would be a unifying theme to investigate in many areas around the North Atlantic. Kurt Tande spoke about the three orders of scale to be found in the TASC programme, from basin scale to mesoscale to individual dynamics and physiology. The TASC Symposium will deal with all of these scales and the intention is to hold a Theme Session at the ICES ASC in 2000 to apply the results from TASC to questions about fisheries variability.

A number of conclusions and recommendations concerning future integration resulted from the discussions. Most of these require action by participants at the meeting and may also lead to recommendations for action by ICES at a later date.

Conclusions:

1) Co-ordination of international activity in the area of SW Iceland and the Irminger Sea (by Canadian, Icelandic and German scientists) was identified as desirable. The ICES/GLOBEC office should assist with this.

2) Need for additional concerted action proposed for additional funding to enable basinwide synthesis of data sets having been collected during the GLOBEC years (George's Banks, TASC, Canadian GLOBEC).

3) Planning a Grand Challenge for the North Atlantic which incorporates i) plankton and fish recruitment variability ii) ecosystem state/health iii) role of zooplankton in carbon budgets.

4) The forthcoming (2000) ICES theme session on zooplankton - cod linkages could be an opportunity for discussing and developing new programmes and in particular how to co-ordinate US/Canadian/European funding.

8 JOINT MEETING WITH THE WGPE

TOR g. Prepare the case for a joint meeting with the WGPE

In introducing the discussion Roger Harris reviewed the previous pattern whereby members of the group offered to host future meetings. This had been very successful. At the Santander meeting there had been two proposals, one from a member of the group, Mark Huntley, to hold the 2000 meeting in Hawaii, and one from the Chairman of the WGPE to meet jointly. Subsequently, there had been further contacts with Mark Huntley and members of the PICES community, and Roger Harris had discussed the possible meeting with WGPE, proposed for Bergen, with David Mills. There was then a general discussion in which the desirability of the options was considered. There was concern about the cost implications of Hawaii, but it was pointed out that these might well be less than the venue in Iceland. It was noted that the group had met in Bergen before, and that it had held only one meeting in the United States. It was further felt that the opportunity to link with the PICES community was very timely. There was common interest in monitoring, sampling methods, and GOOS, within the North Atlantic and North Pacific. The publication of the ICES Manual made the meeting timely. It was also noted that many of the topic proposed by the WGPE were not direct developments of the work of the WGZE, and would require more preparative work. However, there were topics of potential interest, monitoring being one. Further convergence of the interests of the two groups might be sought. The discussion concluded with the agreement that the Hawaii venue be recommended for the 2000 meeting, and that there should be further dialogue with the WGPE with a view to developing a common agenda of mutually appropriate topics, perhaps for the 2001 meeting.

9 OCEANOGRAPHY COMMITTEE FIVE-YEAR PLAN

TOR h. Propose tactics, activities and products in support of the Oceanography Committee's Five-year Plan Objectives

The discussion was introduced by Keith Brander and Ute Zeller acted as Rapporteur

Last year (1998) at the Annual Science Conference The Oceanography Committee presented the five-year plan, since that had been reviewed. The objectives are:

1. Understanding the physical and biological function of marine ecosystem
2. Understanding and quantifying human impacts on the marine environmental
3. Developing the science of integrated marine living resource management
4. Co-ordinating and supporting interdisciplinary, national and international marine science programs

The Global Ocean Observing System(GOOS) is an international programme preparing a permanent global framework of observations, modelling and analyses of ocean variables needed to support operational ocean services. One of the criteria in the frame of GOOS (Global Oceanic Observing System) is beside physical and chemical data to include also biological data sets. At this point the working group can provide a high input principally on objective 2 concerning the long time investigation carried out on zooplankton stocks in the ICES area.

Monitoring of zooplankton and routine use and assessment of data from the monitoring could constitute an element in a regional North Atlantic GOOS component. The 1999 meeting of the WGZE propose considering plans for a co-ordinated zooplankton monitoring programme for the ICES area, based on national programmes, as a contribution to the North Atlantic regional GOOS.

Roger Harris closed the meeting by thanking all members for their contributions to the discussion, and Olafur Astthorsson and Astthor Gislason for their excellent organisation. The hospitality of the Director, and the Marine Research Institute, was much appreciated.

10 RECOMMENDATIONS

1. The Working Group on Zooplankton Ecology will meet for three days in the second half of April 2000 at the University of Hawaii, at the invitation of Dr Mark Huntley and PICES, to:

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 the workshop on taxonomy of calanoid copepods to be held in May 2000 in Germany

g) Consider plans for the EU ENRICH proposal to further basinwide 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.

2. Dr Harris (UK) has served as chair of this WG for three years and the group propose that Dr L Valdes (Spain) should take his place.

3. ICES member states should be invited to designate existing regular, routine zooplankton monitoring activities as ICES GOOS components.

4. The proposed workshop on taxonomy of calanoid copepods should be supported as an initial step towards consolidating taxonomic expertise.

Justification:

1. The invitation from PICES to hold a meeting in Hawaii 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 ICES and PICES has been mentioned frequently in the past and this is an excellent opportunity to tackle a well defined agenda of common interests.

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 and proposes a workshop, 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.

2. Dr Valdes is a longstanding member of the committee and is willing to undertake the task.

3. The development in relation to GOOS is a natural development of the long-standing WGZE activity in the area of zooplankton monitoring.

4. This workshop will be a practical step towards strengthening taxonomic skills in the ICES community.

ANNEX 1

ICES Working Group on Zooplankton Ecology
Reykjavik, 19–21, April 1999

LIST OF PARTICIPANTS

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ANNEX 2

ICES Working Group on Zooplankton Ecology
Reykjavik, 19–21, April 1999

AGENDA AND PROGRAMME

Monday 19 April

09:00 – 12:30	**OPENING, AGENDA, MEETING PROGRAMME**
	ZOOPLANKTON METHODOLOGY MANUAL (Chair: Roger Harris) *TOR b. Report on the final aspects of publication of the Zooplankton Methodology Manual*
	1993 SEA-GOING WORKSHOP: RESULTS AND PLANS FOR PUBLICATION (Chair: Peter Wiebe, Rapporteur: Steve Hay) *TOR a. Continue the review of the results of, and plans for publication of, the 1993 Sea-Going Workshop*
12:30 – 14:00	Lunch
14:00 - 17:00	**SEA-GOING WORKSHOP (CONTD)**

Tuesday 20 April

09:00 – 12:30	*STATUS OF ZOOPLANKTON STOCKS IN THE ICES AREA; ZOOPLANKTON MONITORING (NORTH ATLANTIC REGIONAL GOOS)* (Chair: Keith Brander, Rapporteur: Sonia Batten,) *TOR c. Report on the status of zooplankton stocks in the ICES area, and consider plans for a co-ordinated zooplankton monitoring programme based on national programmes as a contribution to a North Atlantic regional GOOS*
12:30 –14:00	lunch
14:00 - 17:00	**ENVIRONMENTAL INDICES INVOLVING ZOOPLANKTON POPULATIONS** (Chairs: Doug Sameoto and Olafur Astthorsson; Rapporteur: Bill Silvert) *TOR d. Consider the development and application of environmental indices involving zooplankton populations, and the standardisation of products from zooplankton monitoring data*
(14:00 - 17:00 contd.)	**INVENTORY OF ZOOPLANKTON TAXONOMISTS; TAXONOMY WORKSHOP** (Chairs: Luis Valdez and Emilia Cunha, Rapporteur, Heino Fock) *TOR f. Review an inventory, compiled intersessionally, of zooplankton taxonomists for the major taxa and prepare plans for a workshop on zooplankton taxonomy*

Wednesday 21 April

09:00 – 12:30	**CONSIDER PLANS FOR TRANS-ATLANTIC CO-ORDINATED RESEARCH ACTIVITIES (GLOBEC)** (Chairs: Peter Wiebe and Kurt Tande, Rapporteur: Keith Brander) *TOR e. Consider plans for trans-Atlantic co-ordinated research activities in the context of GLOBEC* **JOINT MEETING WITH THE WGPE** (Chair:Roger Harris, Rapporteur: Santiago Hernandez-Leon) TOR g. Prepare the case for a joint meeting with the WGPE **OCEANOGRAPHY COMMITTEE FIVE-YEAR PLAN** (Chair: Keith Brander, Rapporteur: Ute Zeller) *TOR h. Propose tactics, activities and products in support of the Oceanography Committee's Five-year Plan Objectives* **CHAIRMANSHIP OF THE WGZE**
12:30–14:00	lunch
14:00 -	**SUMMARY DISCUSSION, DRAFTING AND COMPLETION OF REPORT, FUTURE PLANS** **INFORMAL DISCUSSION OF FUNDING OPPORTUNITIES AND PLANS: EU VTH FRAMEWORK PROGRAMME**

Justification:

a) A large amount of valuable data on intercomparsion of sampling systems were collected during the seagoing workshop; the WGZE consider it timely to review the analysis of this data with a view to planning a special publication.

b) Completion of technical aspects of the publication of Zooplankton Methodology Manual is the highest priority during the coming year; the 1999 meeting will enable the WGZE to review the final outcome of this project.

c) Having identified the active zooplankton monitoring activities in the ICES area, the members of WGZE agree that the work should form the basis for an annual report, and exchange of information on, significant observations and trends in those zooplankton surveys and time-series; such further co-ordination would contribute towards GOOS.

d) The work on zooplankton monitoring has emphasised the importance of standardisation of data analysis and presentation, with a view to developing environmental indices, which can be used for comparative purposes within the ICES area.

e) In the context of the development of the 5 year plan the WGZE consider it would be valuable to evaluate further opportunities for practical Trans-Atlantic coordinated research; this would be considered in the context of GLOBEC initiatives in the region.

f) Concern was expressed at the last meeting of the WGZE about the loss of taxonomic expertise within the ICES zooplankton community; development of an inventory of zooplankton taxonomists will be a step towards addressing this problem. The recommendation concerning the workshop stems from discussion at ACME.

g) This is to respond to a desire from WGPE

h) At the 1998 Annual Science Conference, The Oceanography Committee agreed a set of draft objectives, yet to be ratified. The Committee invites the working group to provide relevant input based on these objectives.

ANNEX 3

Zooplankton monitoring activities in the ICES area

1999 Zooplankton Monitoring Activity Report – UNITED KINGDOM

(A) Continuous Plankton Recorder Monitoring data update.

The Continuous Plankton Recorder is deployed monthly on approximately 20–25 standard routes across the North Sea and North Atlantic (see figure). During 1998, a total of 4105 samples were collected and analysed on these routes, representing 82,609 sampled nautical miles and a small increase of 3.5% on the sampling during 1997. Sampling began in the Baltic for the first time in September 1998, although subsequent tows will be analysed for plankton abundance in Finland rather than the UK. A route along the Iberian margin was also restarted in mid-1997 for the European Union funded project OMEX (Ocean Margin Exchange). It is hoped that this route can continue to be funded once the project fieldwork is completed in December 1999 since a wealth of CPR data already exists for this region from 1958 to 1990. Unusually high numbers of oceanic species were recorded in the North Sea during 1997 and 1998, including some previously unrecorded species in this area, which suggests an unusually high inflow of oceanic water (Edwards *et al.*, in press), probably linked to meteorological anomalies. This influx contributed to an increasing trend in biodiversity of North Sea plankton, as measured by the CPR, seen over the last decade. An increase in the contribution of the meroplankton to the plankton community of the North Sea has also been noted.

Routine instrumentation of CPRs is expanding. Many are now deployed with a simple temperature sensor and some carry a more sophisticated instrument package that measures salinity, temperature and fluorescence. These data are invaluable in providing supplementary information on the physical environment of the plankton. Several CPRs are also fitted with electromagnetic flowmetres to quantify the volume of water filtered per sample. Preliminary results (Walne *et al.*, 1998) suggest that whilst the accepted 3 m^3 (calculated from the aperture times the distance towed) may be a realistic average, when plankton densities are high the actual filtered volume may be significantly lower, owing to clogging. This implies that plankton densities calculated from the CPR may be an underestimate when densities are high, in the spring for example. The flowmetres should enable a backwards calibration of the CPR data and absolute densities to be determined. The undulating replacement vehicle for the CPR, the U-Tow, is also undergoing continuing development. Sea trials have progressed well, with the device currently capable of undulating to depths of 60 m at speeds of about 15 knots.

References:

Edwards, M., John, A.W.G., Hunt, H.G. & Lindley, J.A. (In press). Exceptional influx of oceanic species into the North Sea in late 1997. *Journal of the Marine Biological Association of the United Kingdom.*
Walne, A.W., Hays, G.C., and Adams, P.R. (1998) Measuring the filtration efficiency of the Continuous Plankton Recorder. *Journal of Plankton Research*, **20,** 1963–1969.

(B) Steve Hay - FRS Marine laboratory Aberdeen, Scotland Zooplankton Monitoring from Aberdeen

1. Since 1997 a site located some three miles offshore of Stonehaven to the south of Aberdeen (56deg 57.8' N 02deg 06.2' W) in North Sea water 50 m deep, has been sampled when possible at weekly intervals. Originally an element of the TASC project the sampling is to continue for the forseeable future and it is hoped to expand the analysis to include more complex taxonomic analysis than is presently done. The site is also one of a number of sites around the Scottish coast monitored by FRS Marine Laboratory in Aberdeen for the presence of toxic phytoplankton species. Some of these data are displayed on our web site (http//www.marlab.ac.uk).Sampling includes:

Temperature, Salinity, Nitrate, Ammonia, Phosphate and Silicate analysis of samples at the surface and at 45 m depth.
Depth integrated (hose sampler), lugol's Iodine preserved water samples for phytoplankton species analysis.
Water samples filtered and analysed for Chlorophyll.

Zooplankton samples collected by vertical Bongo net tows (95 and 200 micron meshes).

2. There is also a recent extension to our routine hydrographic sampling in the Faroe –Shetland Channel to include multi-depth plankton sampling at key sites on the years end (December) cruise.

This sampling is targeted at evaluating the depth distribution and density of overwintering Calanus finmarchicus populations in relation to prevailing hydrographic conditions in the area. This is being done to relate these data to variability in North Atlantic hydrography/ climate and to variability in the spring influx of Calanus to the northern North Sea where they provide a major food source for developing fish larvae.

1999 Zooplankton Monitoring Activity Report – GERMANY

Helgoland Roads (German Bight, southern North Sea): Status of zooplankton stocks in 1998

After cessation in 1995–1997 zooplankton (processing not completed yet) analysis was continued in 1998 up to present. While comparing present results with the preceding period 1975–1994 considerable differences for two groups of taxa can be discerned (plankton from 150 µm-net, vertical hauls):

In 1998 lower than the average of 1975–1994	**In 1998 higher than the average of 1975–1994**
Calanus spp.	*Corycaeus anglicus*
Acartia spp.	nauplii
Pseudo-/Paracalanus spp.	*Noctiluca scintillans*
Temora longicornis	*Fritillaria borealis*
polychaete larvae	*Oikopleura dioica*
cladocerans	juv. *Pleurobrachia pileus*
	Sagitta spp.

For two selected biological features time series are presented (Figure 1): (1) *Calanus* spp. (mostly consisting of *C. helgolandicus*, Hülsemann pers. comm.) and (2) small calanoid copepods (comprising *Acartia, Pseudo/Paracalanus, Temora, Centropages*).

Despite high levels of nutrients (DIN; however: reduced phosphate levels) and elevated temperatures in the 90's (SST) copepod numbers decreased after 1990 and for *Calanus* spp. returned to a level reached in the 70's. Figure 2 shows that the decline of Calanus-stocks in 1998 did not occur throughout the whole year, but that in certain weeks higher than average abundances were recorded.

Besides decreasing phosphate concentrations after 1990 wind conditions changed abruptly after 1989, indicating increased strength of winds stronger than the long-term mean 4.15 Beaufort (wind-index > 1), whereas weaker winds prevailed in the preceding time period (index< 1). In the calculation of the wind-index all wind directions are included (note: westerly wind at Helgoland follow the NAO-index). Our hypothesis is that wind strength and by this wind induced turbulence might be one cause for the decline of copepod stocks after 1990. Mechanisms could be a mismatch with the - probably delayed - phytoplankton bloom (referring to Fromentin and Planque, 1996), and unfavourable feeding conditions due to very high turbulence (referring to McKenzie *et al.*, 1994). Additionally increased abundances of carnivorous plankton (*Pleurobrachia, Sagitta*, decapod larvae) could have an effect on the copepod plankton. Investigations will be continued.

Fromentin, J.-M., and B. Planque. 1996. *Calanus* and environment in the eastern North Atlantic. II. Influence of the North Atlantic Oscillation on *C. finmarchicus* and *C. helgolandicus*. *Mar. Ecol. Prog. Series*, 134:111 - 118.

McKenzie, B., T. Miller, S. Cyr, and W. Leggett. 1994. Evidence for a dome-shaped relationship between turbulence and larval fish ingestion rates. *Limnol. Oceanogr.*, 39:1790–1799.

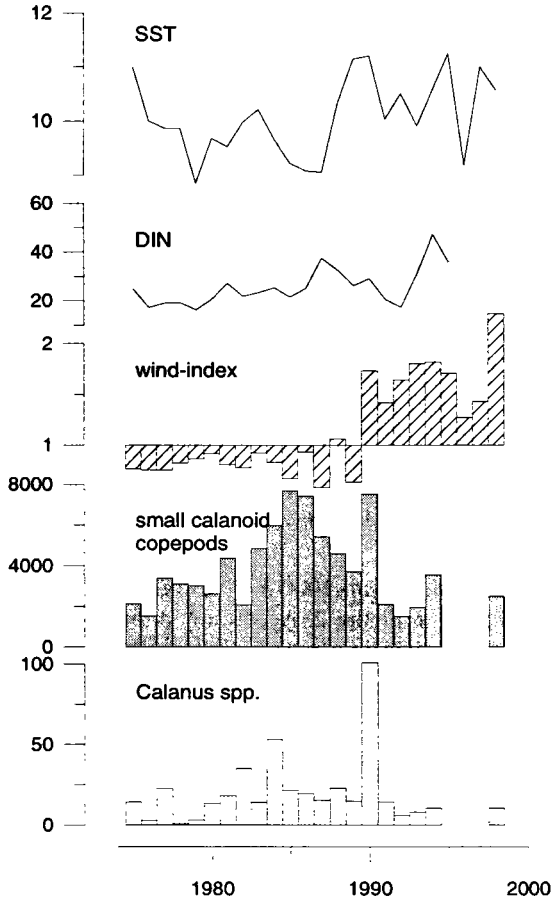


Figure 1:
Time series of annual means for sea surface temperature (SST, in °C), dissolved inorganic nitrogen (DIN, in mmol m^{-3}), wind-index (rel. units expressing ratio of winds stronger than 4.15 Beaufort to weaker winds), small calanoid copepods and Calanus spp. (both in n m^{-3}). Zooplankton data missing in 1995–97, DIN data available only up to 1995. Plankton data from 150 µm-net samples.

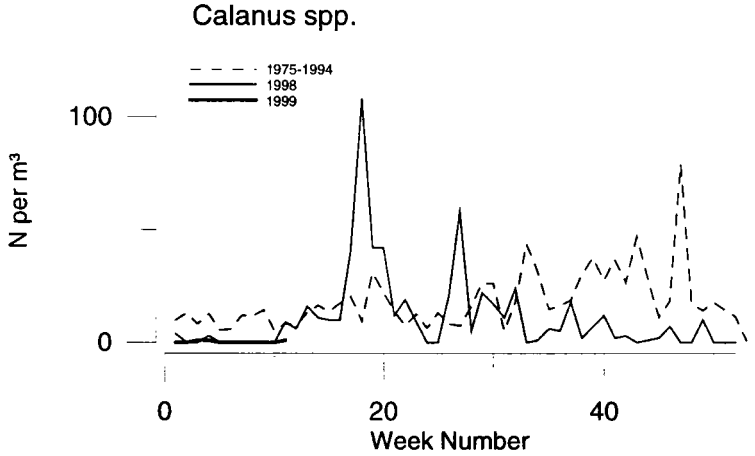


Figure 2:
Weekly abundances in 1998 (thin line) and 1999 (bold line, only up to week 11) for Calanus spp. compared to long-term average of weekly abundances of 1975–1994. Plankton data from 150 µm-net samples.

1999 Zooplankton Monitoring Activity Report – PORTUGAL

Portugal has not had a program of zooplankton monitoring since 1989. From then on zooplankton data came from a variety of ground fish surveys where sampling has been done for fish eggs and larvae of the target species. As a result, information on the plankton samples is dispersed among an array of people involved with different programs.

To deal with the lack of zooplankton data during that time period we collected information on fisheries surveys which sampled for egg and larvae, including the time, locations, and sampling devices used in these cruises. The state of processing of the samples was investigated and the samples that were not processed or that there was doubts about are under review.

An example of the information that was gathered is the zooplankton biomass obtained during the cruises for Daily Egg Production Method (DEPM) for sardine spawning stock biomass evaluation (Figure 1). There were three cruises (1988, 1997 and 1999) covering the entire sardine spawning area from the Strait of Gibraltar to the northern Portuguese/Spanish border. These cruises have a very dense grid of stations (6x6 miles apart) with vertical plankton hauls (CalVET with 150 µm mesh size) and temperature/depth records. Due to the dense grid such cruises will be *important for studies on horizontal small-scale phenomena.*

The mean zooplankton displacement volume (ml.1000 m^{-3}) off the northern Portuguese coast from the period of 1986 to 1988 and 1990 to 1992 period is shown in Figure 2. According to this figure there was no difference between the levels of zooplankton abundance during these two time periods The two periods correspond to two different sets of samples obtained with the same sampling device, a Bongo net equipped with 335 and 505 um mesh sizes. The set from 1986 to 1989 is from monthly sampling of two lines off Porto (6 stations) and Figueira da Foz (7 stations) (see Fig 1). The second set is from 6 ground fish surveys that were carried on in February, July and October, from 1990 to 1992. Stations located along lines of similar latitudes for the monthly sampling were chosen for the calculation of the mean zooplankton volume.

Figure 1 - Zooplankton abundance (ml/10 m3) in February 99

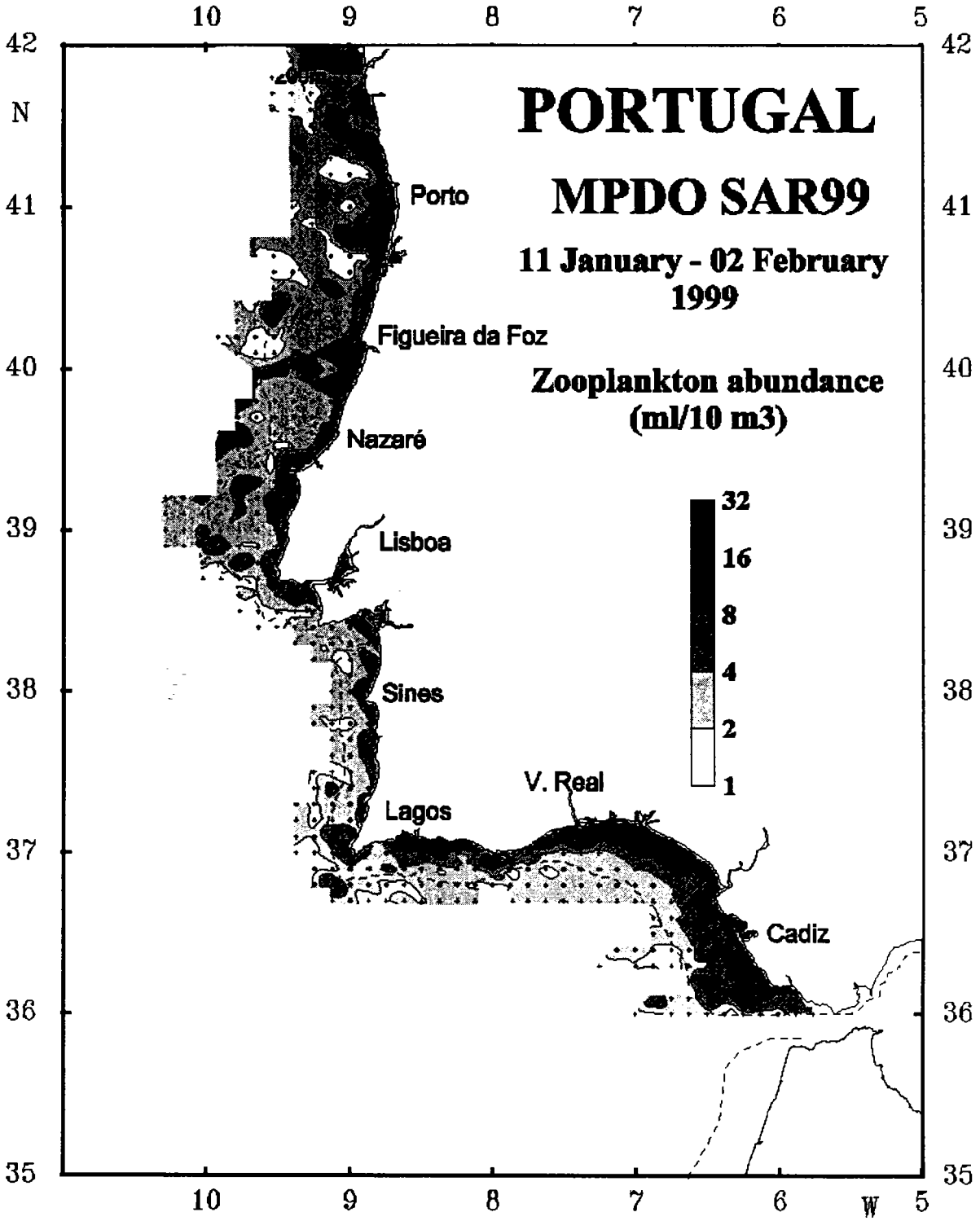
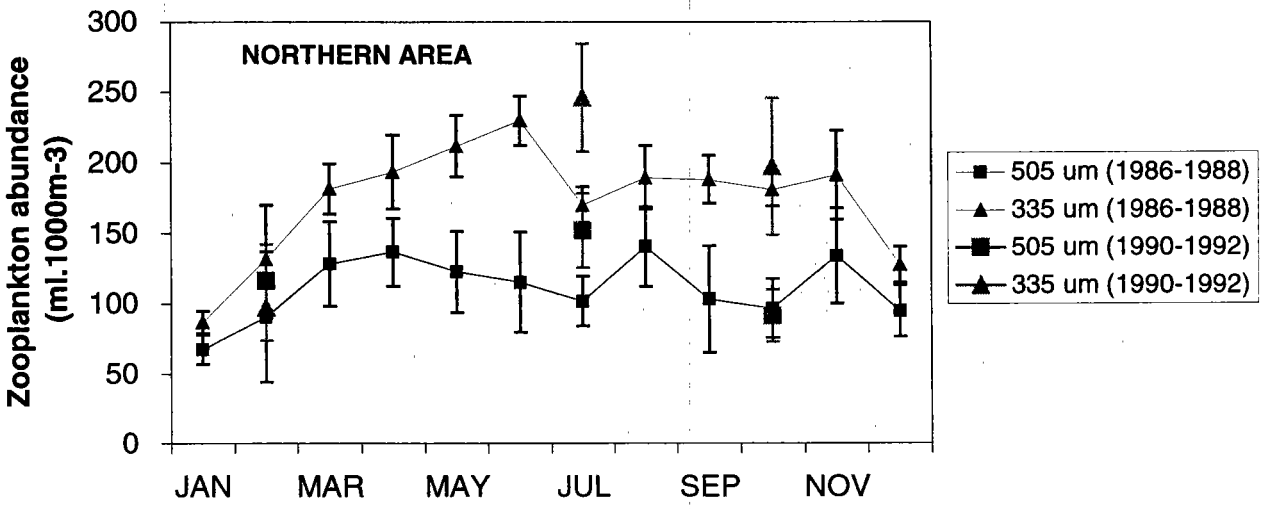


Figure 2 – Monthly mean zooplankton abundance off the northern Portuguese coast during the periods of 1986–1988 and 1990–1992.



Zooplankton investigations in Icelandic waters 1997 and 1998

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Zooplankton biomass in Icelandic waters has been monitored annually in May/June for more than 30 years. These investigations began as part of a programme to search for migrations of the Norwegian spring spawning herring, arriving in their feeding area north of Iceland in spring, and monitor their movements and behaviour in the following months. Since the decline of the herring fishery in the waters north of Iceland in the late sixties the zooplankton investigations have been continued as apart of a general environmental survey in spring. The investigation area now covers the waters all around Iceland and samples are taken both from shelf and offshore waters. These investigations are of importance to increase the knowledge on the changing environmental conditions in the waters around Iceland and how these are linked to or reflected in the status of the exploited fish stocks in Icelandic waters.

The samples are collected with WP-2 net which is towed vertically from 50 m to the surface. Biomass is determined at sea and also a short cut analysis is made of the composition of the samples. More detailed analysis of samples from selected stations is later made the laboratory onshore.

1997

In 1997 the zooplankton investigations around Iceland were carried out as part of the spring survey, from 21 May to 10 June. In addition zooplankton was also sampled during two cruises in the Norwegian Sea (4–23 May and 3–14 June) in connection with joint Icelandic, Norwegian, Faroese, Russian and EU research effort to investigate the distribution of the Atlanto-Scandian herrring in that area. Figure 1A shows the distribution of the zooplankton biomass east of Iceland and in the Norwegian Sea during the first of the herring surveys (4 - 23 May) while Figure 1B shows the distribution as measured during the Icelandic spring survey and during the latter one of the herring surveys.

During 2–23 May 1997 zooplankton biomass was low in the shelf waters east of Iceland, while off the shelf and in the Norwegian sea it was was much higher (Figure 1A). The biomass was greatest in an area of a NW - SE direction from 67° N, between 4° and 11° W, and towards 64° N, 1° V (> 10 g dw m^{-2} at 0–50 m). The high biomass decreased again to the east of this area. In the northwestern part of the investigation area (approximately west of 6° W and north of 65° N) cold water species (*Calanus hyperboreus, Metridia longa*) dominated while in the eastern part Cal*anus finmarchicus* was the dominating species.

During the latter part of May and in early June the zooplankton biomass had increased markedly from that observed during early May. The zooplankton biomass was greatest in the cold waters to the north and northeast of Iceland (Figure 1B) and as during the previous cruise the large cold water species dominated in these waters. In this area the zooplankton biomass was just above the long term average. Off the west coast of Iceland the zooplankton biomass was similar to the long term average while above it in the waters to the north. Off the south coast, on the other hand, the zooplankton biomass was generally below the long term average. When the results from 1997 are compared to those from 1996 it is evident that in the waters to the east it was lower, to the south and west it was similar, while in the waters to the north-west and north it was lower in 1997 than in 1996. For the whole of Icelandic waters the zooplankton biomass in 1997 was above the long term average.

1998

The annual spring survey of Icelandic waters in 1998 was undertaken between 26 May and 16 June. As in 1997 the zooplankton biomass distribution in the Norwegian Sea was also investigated in conjunction with herring survey in that area (5 May - 27 May).

During May the zooplankton biomass in the Norwegian Sea was greatest in two areas of a north - south direction, on one hand between 4 - 6° E, and on the other east of 0° (Figure 2A). Further high biomass was also observed in a tongue between these areas north of 66° N. As usual cold water species were most abundant on the northwestern part of the investigation area, while *Calanus finmarchicus*, dominated in other areas.

During the latter part of May and early June (Figure 2B) the zooplankton biomass was, as commonly, greatest in the cold waters to the north-east of Iceland. In this area the biomass was somewhat above the long term average, but on the

other hand lower than in May/June 1997. The zooplankton biomass was also above average to the west of Iceland. Off the north coast the biomass was close to the long term average, while to the south of Iceland the biomass was below the long term average.

When compared to 1997, the spring zooplankton biomass in 1998 was found to be higher in the waters to the south and west, similar in the waters to the east, but lower to the north of Iceland. For the whole of Icelandic waters the zooplankton biomass in 1998 was simlar to the long term average

Long term changes in spring zooplankton north and south of Iceland

Long term changes in zooplankton biomass at Siglunes transect from the north of Iceland abd at Selvogsbanki from the south are shown in Figure 3. At Siglunes the values represent averages from 8 stations, while on selvogsbanki the vatues are averages from 5 stations.

North of Iceland the high values of zooplankton in the beginning of the series dropped drastically with the onset of the Great Salinity Anomaly of the 1960s (Figure 3A). Since then zooplankton biomass has varied with highs at approximately 7–10 years intervals. The highest and lowest values differ by a factor of about 24. The last peak in zooplankton biomass occurred around 1994, while since then the biomass has been declining.

On the Selvogsbanki transect the zooplankton biomass showed a peak during the early 80's while a low was observed during the late 80's (Figure 3B). The zooplankton biomass showed another peak around the middle of the 90's, while a decrease was then observed until the end of the 90's. A peak was also observed around 1995 but since then zooplankton biomass on the Selvogsbanki transect has been decreasing. The time period between the zooplankton peaks on the Selvegsbanki transect has been around 10 years. With the exception of 1977 a more or less synchronous variability has been observed in the Sub-Arctic waters to the north of Iceland and in the Atlantic water to the south of the country.

Although inter-annual changes of the observed zooplankton biomass at Iceland may in part be explained by variable hydrographic conditions and timing of the phytoplankton spring bloom, comparison to other data from the northern North Atlantic shows that observed zooplankton biomass in spring is descriptive of the mean copepod biomass in that year. Recent research also shows that the variation of zooplankton biomass in the Icelandic area is in tune with long term variability of zooplankton abundance over a much larger area, i.e., in the northern North Atlantic in general (see Astthorsson and Gislason, Long term changes in zooplankton biomass in Icelandic waters in spring, ICES J. Mar. Sci., 52:657–668. 1995).

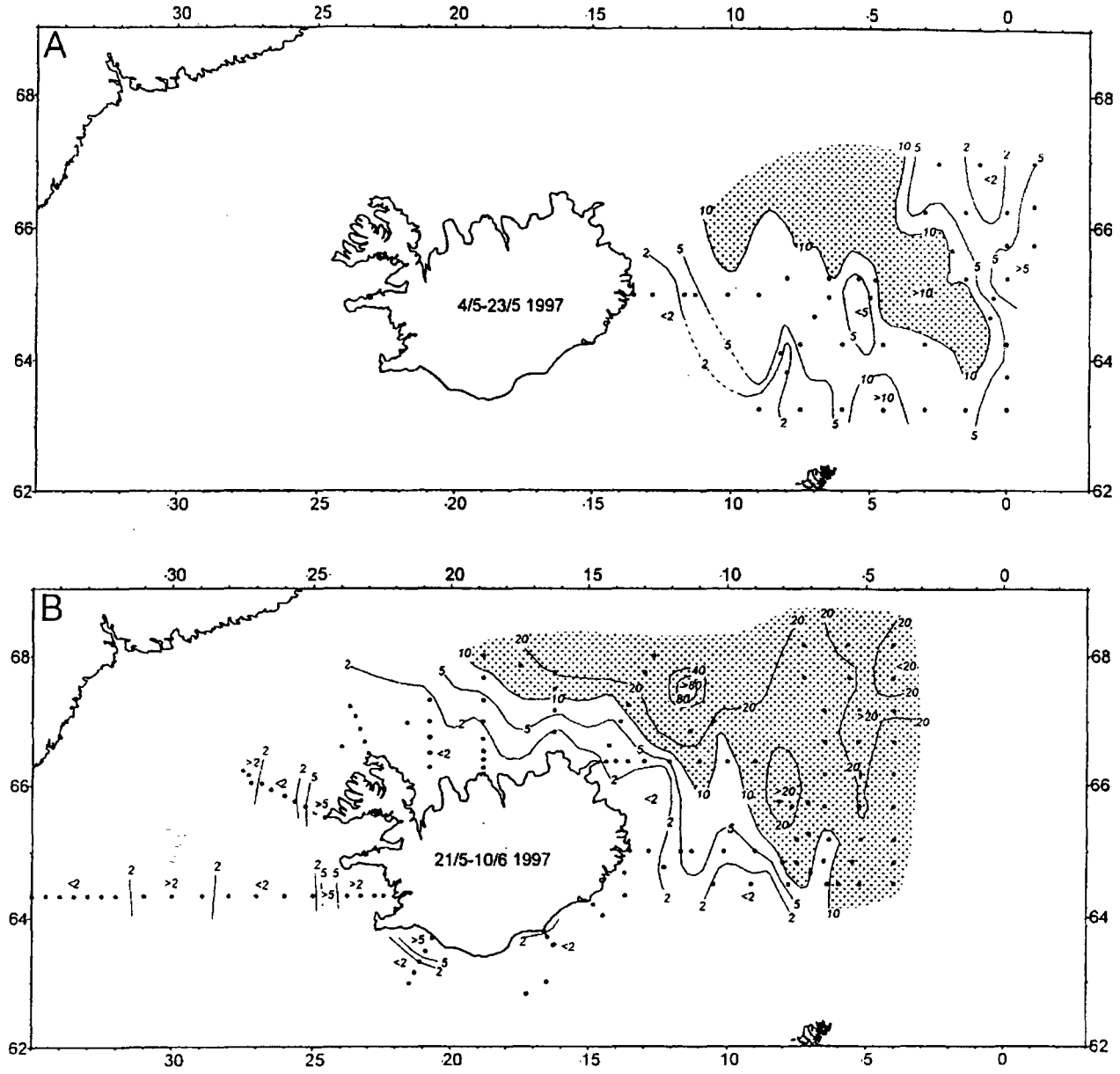

Figure 1. Zooplankton distribution (g dryweight m^{-2}, at 0-50 m) in the sea around Iceland, 4-23 May 1997 (A) and 21 May - 10 June 1997 (B).

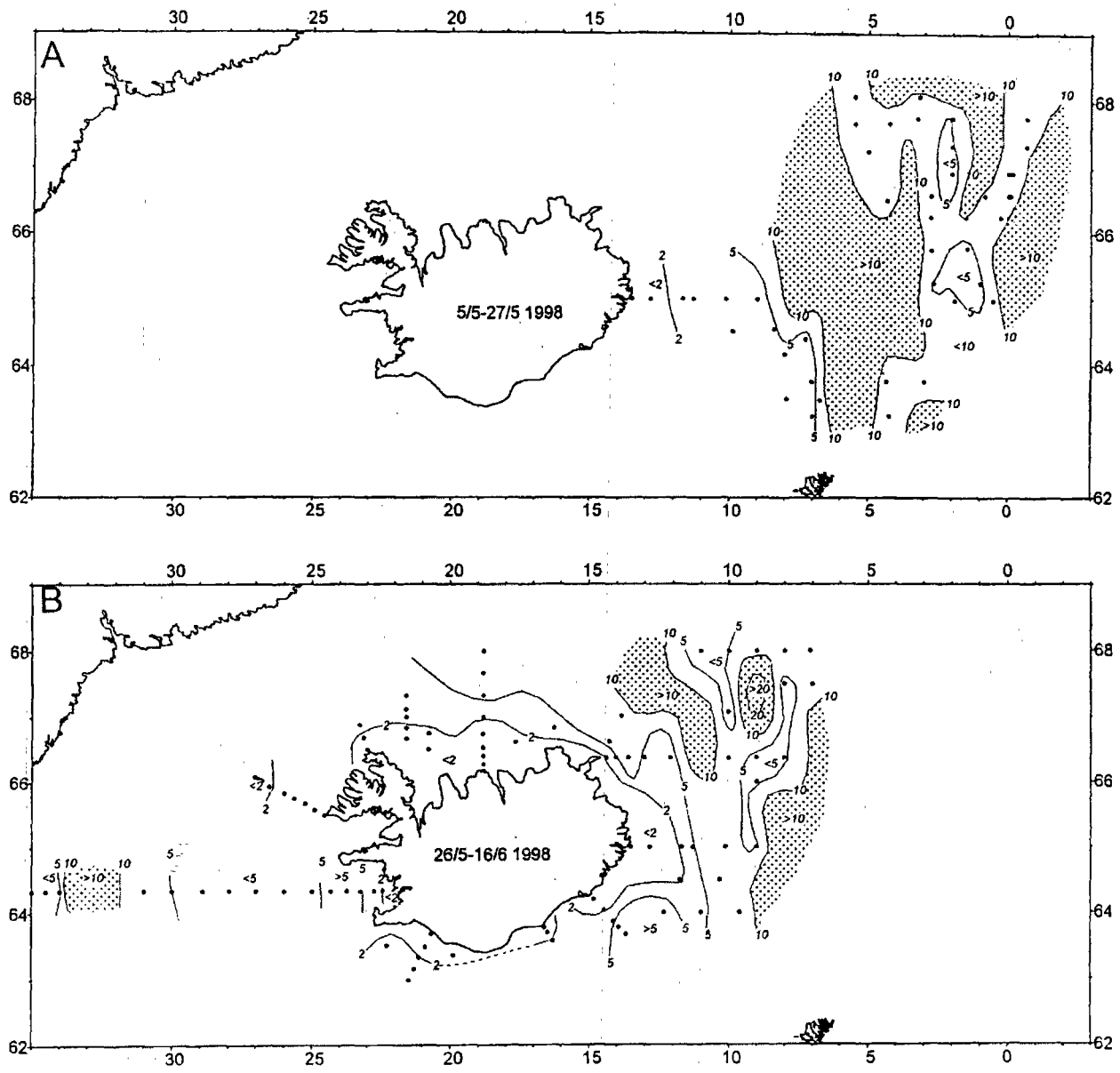

Figure 2. Zooplankton distribution (g dryweight m^{-2}, 0-50 m) in the sea around Iceland, 5-27 May 1998 (A) and 26 May - 16 June 1998 (B).

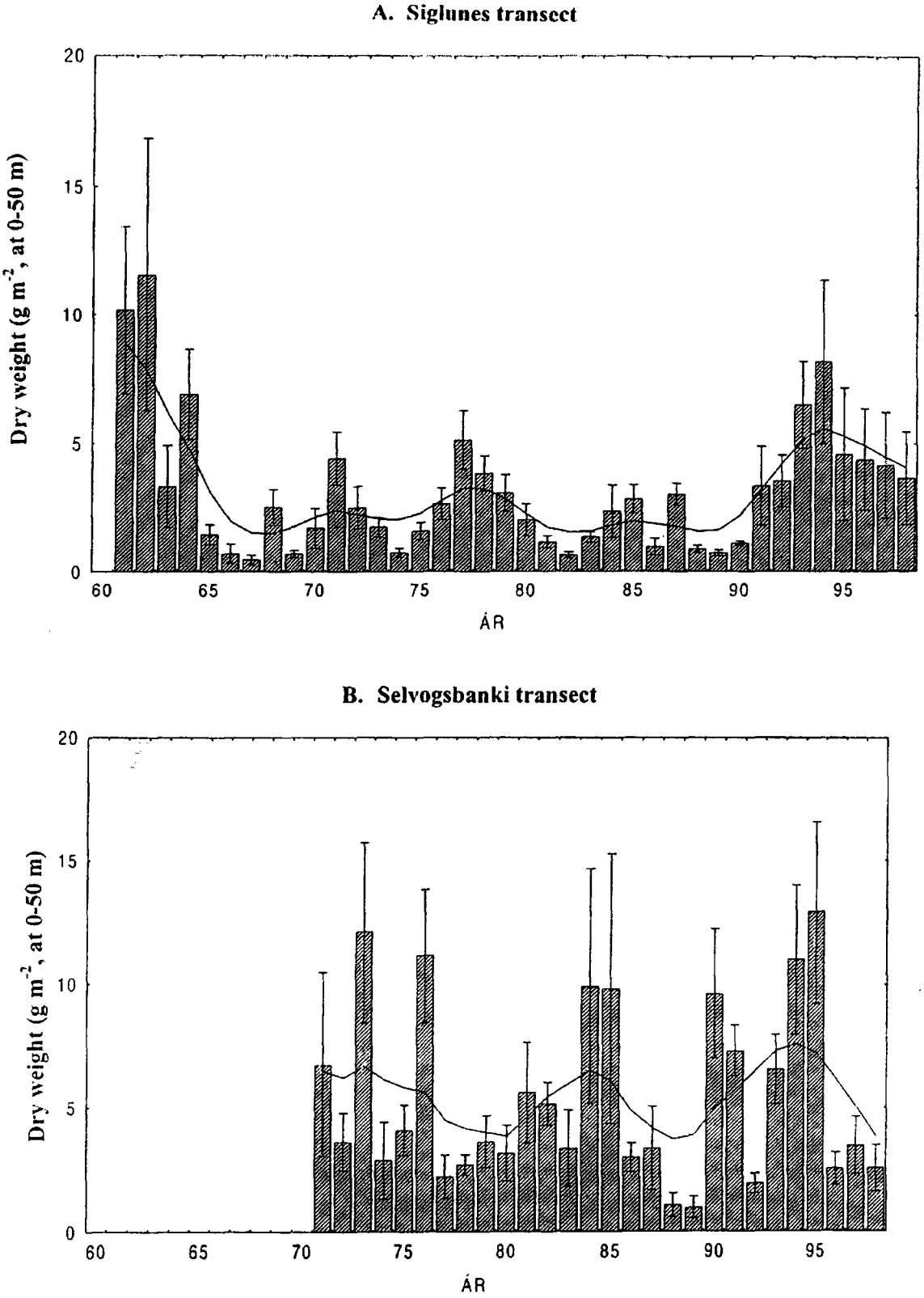

Figure 3. Variations in zooplankton biomass (g dry weight m^{-2}, 0-50 m) in spring at Siglunes section (A) and Selvogsbanki section (B). The columns show means for all stations at the respective sections and the vertical bars denote standard error. The curved line shows 7 year running mean. For location of the sections see Figures 1 and 2.

Zooplankton investigations in the Norwegian and Barents Seas 1998

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Zooplankton sampling in 1998 has been performed with MOCNESS sampler and WP-2 net regularly along two transects, the Svinøy and Gimsøy transects, and at cruises covering large parts of the Norwegian and Barents Seas. Frequent sampling (up to twice a week) has been performed with WP-2 net and Multinet until August at weather station M (66°N, 02°E).

Norwegian Sea

Zooplankton

The eastern and central parts of the Norwegian Sea were investigated in May both in 1997 and 1998. While we observed a mean biomass of 8.4g dw m^{-2}, all stations pooled, in 1997, the mean biomass in the same area in 1998 had increased to 12,2 g dw m^{-2}. The increase was most pronounced in the eastern part of the Norwegian Sea (east of 2°W) where the biomass had increased close to 80% from one year to the other.

The same part of the central and eastern Norwegian Sea has been investigated in July-August over the last five years. Since these investigations started in 1994, there has been a marked reduction in zooplankton biomass (Figure 1). An apparently increasing biomass in 1997 is probably caused by a) a somewhat earlier survey this year (June-July), a period when the biomass in the Norwegian Sea usually is higher than later in the summer and d) a late production of GI *Calanus finmarchicus* that year.

Figures 2a and b show the zooplankton biomass at the Svinøy transect in 1996, 1997 and 1998, at the eastern and western part of the transect, respectively. In the eastern part, i.e., mainly over the continental shelf, the biomass was quite low the three first months of the year, ca. 1 g dw m^{-2}, the biomass being almost identical between years. Further west the biomasses were also low in January, while an increase was observed already in February-March. The increase towards a maximum seemed to take place earlier in 1996 and 1998 than in 1997. The phytoplankton bloom was also stronger and took place earlier in 1998 than in the previous year.

Zooplankton versus herring

The zooplankton investigations in the Norwegian Sea are performed in close connection with the ongoing studies of the Norwegian spring spawning herring. The herring is feeding in the Norwegian and Icelandic Seas, and in late years our understanding of the variation in quality of feeding areas between periods has increased. Such periodic variations are connected to biological/hydrogical coupling which is not well described, variations that ive rise to varying conditions for feeding and growth.

The feeding success in herring seems to have been very low in the period 1996-1998, and we are able to produce preliminary results and hypotheses to throw a light upon the causes for such a varying feeding success.

Viewed from the condition (weight/length) of the spawning herring it seems that the biological production was at its highest in the early 1990s. Since 1991 the condition decreased, to reach a minimum in 1997.

At the end of 1996 the hydrological climate in the Norwegian Sea changed, and the northward transport of warm Atlantic water between Shetland and the Faroes increased. The warmer water spread in the Norwegian Sea, which should give rise to better herring feeding conditions and increased weight/length relationalready in 1997.

Such an increase in condition did not take place that year. The phytoplankton production started rather late that year, though the maximum phytoplankton bloom was not delayed relative to previous years. This late start of the primary production led to a delayed production of *Calanus finmarchicus*. In 1996 we observed that the copepodite stages most predated by the herring occurred already in mid-May, in 1997 the same stages were first found in late June. The late start of zooplankton production seems to be unfavourable for the herring. Historical time series indicate that the increase in condition factor is highest in May and June when 70-80% of such an increase takes place. In 1997 the important feeding period of the herring did not match in time with the zooplankton production.

In 1998 the warming of surface layers of the Norwegian Sea continued. The phytoplankton production started earlier than the previous year, so did the production of zooplankton. In the area where the herring was located in May an increase in zooplankton biomass of 80% compared to 1997 was observed. In 1997 we found that the herring, which is a

heavy predator on the zooplankton, performed a fast migration westwards from the Norwegian coast. However, in 1998 the larger part of the herring stock was observed further east, indicating that the better feeding conditions last year retarded their migration towards their feeding area in the west.

Based upon available data on phyto- and zooplankton production, hydrography and herring feeding in the period 1993-1998, we might have sufficient information to establish models which in spring may predict the herring feeding conditions in summer. Such models may also have prognostic values for several years, based upon prognoses for long time changes in ocean climate.

Barents Sea

Since 1986 the distribution and species composition of zooplankton has been investigated in August-September in the Barents Sea. In September the area covered with ice usually is at its minimum. This time of year the phytoplankton production and the predation pressure on zooplankton from fish are reduced, and the zooplankton biomass is a good indicator of the overwintering stock. The main constituent of the zooplankton is *Calanus* spp., which is the main food of pelagic fish as herring and capelin. In September the larger part of the *Calanus* stock has descended to their overwintering depth.

As an ecosystem the Barents Sea is to a large extent dependent upon the transport of Atlantic water carrying plankton from the Norwegian Sea. Especially important is the advection of euphausiids and *Calanus*. During the winter the *Calanus* in the Norwegian Sea is found at great depths, deeper that the bottom depth at the entrance to the Barents Sea, and small amounts of *Calanus* are advected in to the area. Most zooplankton is transported into the Barents Sea and at times this zooplankton is located in surface layers in the Norwegian Sea.

Figure 3 shows the time series (1987-1998) of zooplankton biomass (g dw m^{-2}) in different areas of the Barents Sea in August-September, based upon sampling with WP-2 net (180 µm) from bottom to surface. In the autumn the main constituents are overwintering *Calanus finmarchicus* and *C. glacialis* within the size range 1000-2000 µm. Euphausiids, amphipods and arrow worms make the bulk of the larger organisms ≥ 2000 µm, while small copepods and young copeodite stages of *Calanus* dominate the size group < 1000 µm.

In the period 1991-1994 wer observed a tendency towards an increasing zooplankton biomass in the Barents Sea, and in the north-eastern area (area 8), this increase continued until 1995. Since this time there has been an overall decrease, except in the easternmost area.

An average biomass in the total investigated area of 12.8 g dw m^{-2} in 1994 decreased to 10.7 and 7.4 g dw m^{-2} in 1995 and 1996, respectively. An increase to 10.7 g dw m^{-2} was found in 1997, again followed by a decrease to 8.1 g dw m^{-2} in 1998 (Figure 4). Location of stations in a typical year (1998) is given in Figure 5. The trend in biomass variations in the Barents Sea 1994-1998 is quite similar to the one observed in the Norwegian Sea (Figure 1).

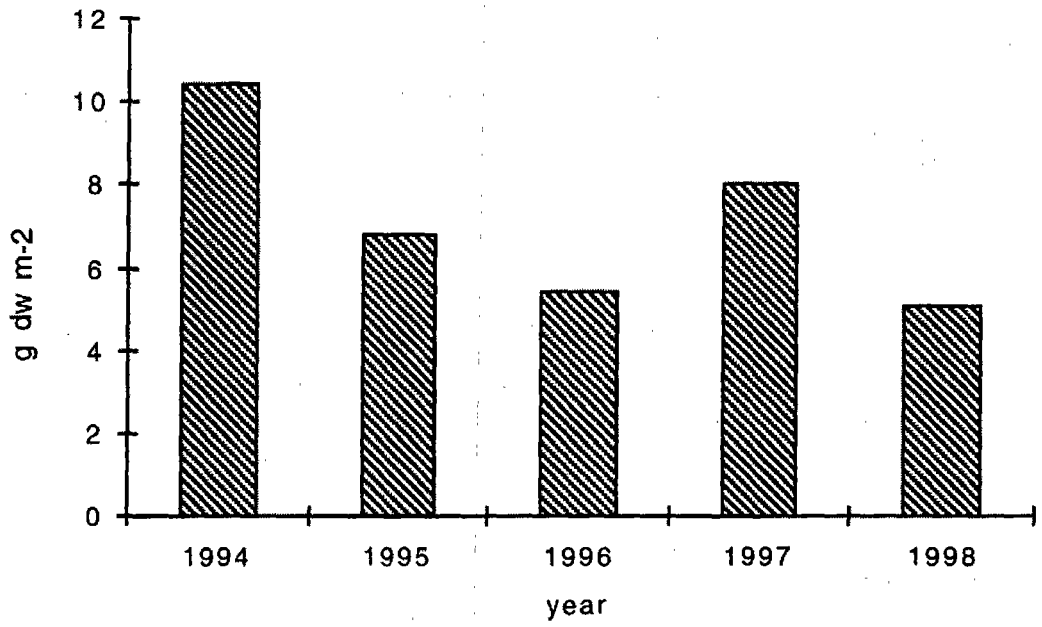

Fig. 1. Mean zooplankton biomass (g dry weight m^{-2}) in the central and eastern part of the Norwegian Sea 1994-1998.

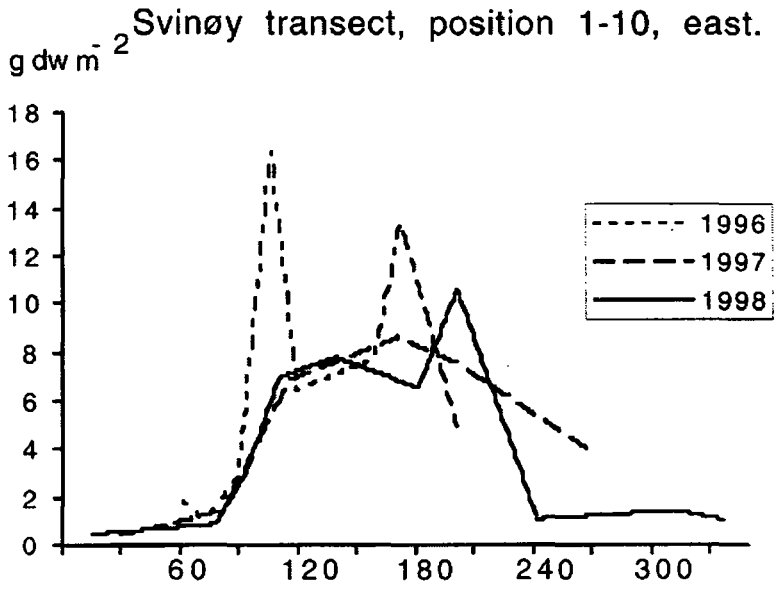

Fig. 2a. Zooplankton biomass (g dw m^{-2}) at the eastern part of the Svinøy transect 1996-1998.

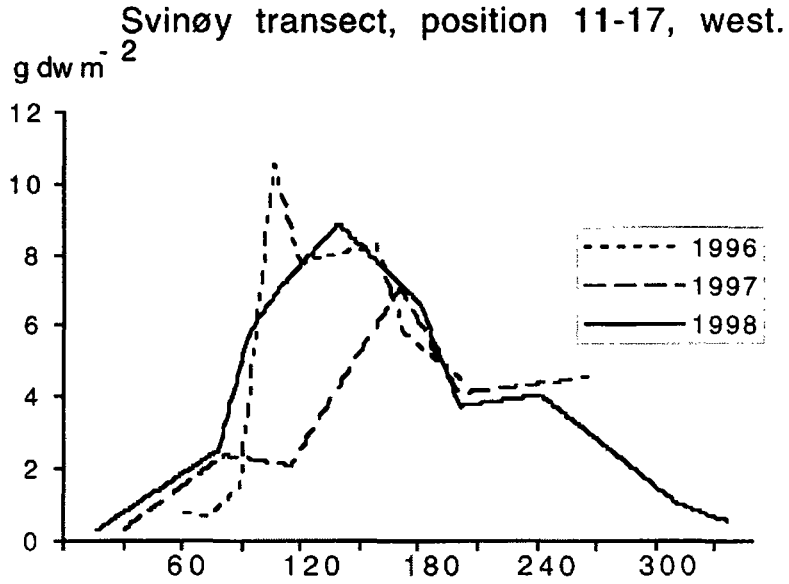

Fig. 2b. Zooplankton biomass (g dw m^{-2}) at the western part of the Svinøy transect 1996-1998

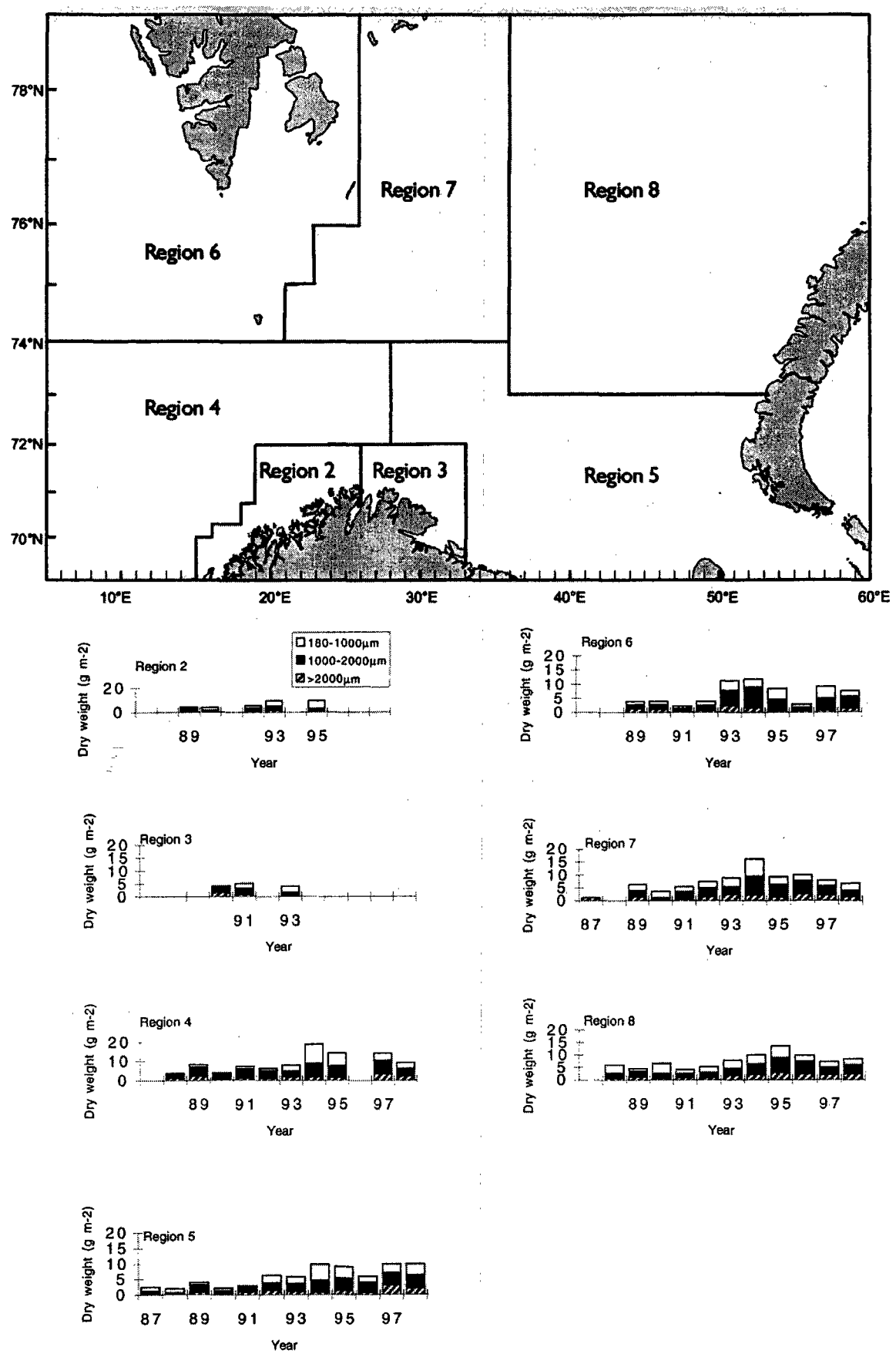

Fig. 3. Mean values of size separated biomass, g m-2 (ash free dry weight 1987-1990, dry weight 1991-1998), from bottom - 0 meter in various parts of the Barents Sea. (Ash free dw is about 80% of dw). Missing columns indicate years when sufficient data are not available for the region.

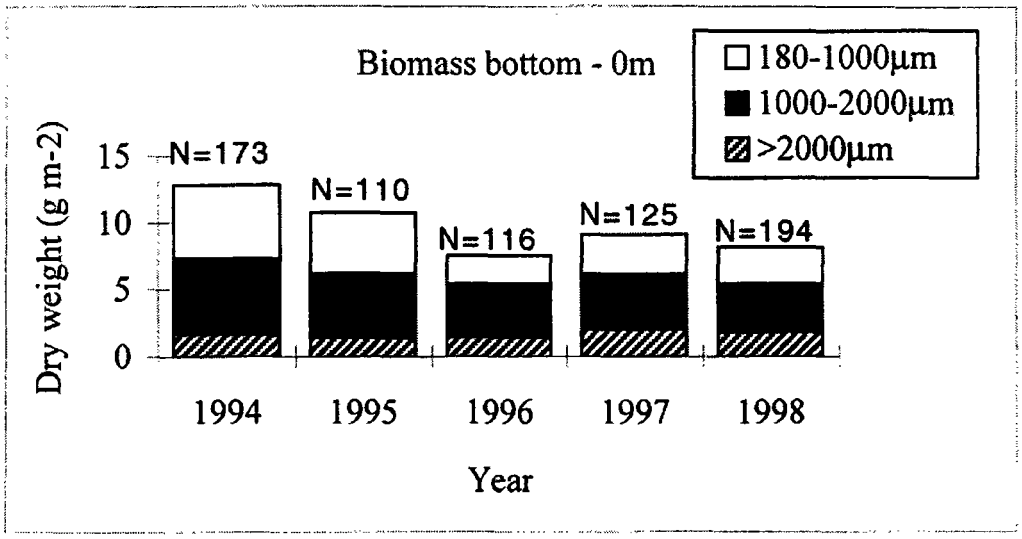

Fig. 4. Zooplankton biomass, mean values for the whole Barents Sea, 1994-1998.

WP2-stasjoner august-september 1998

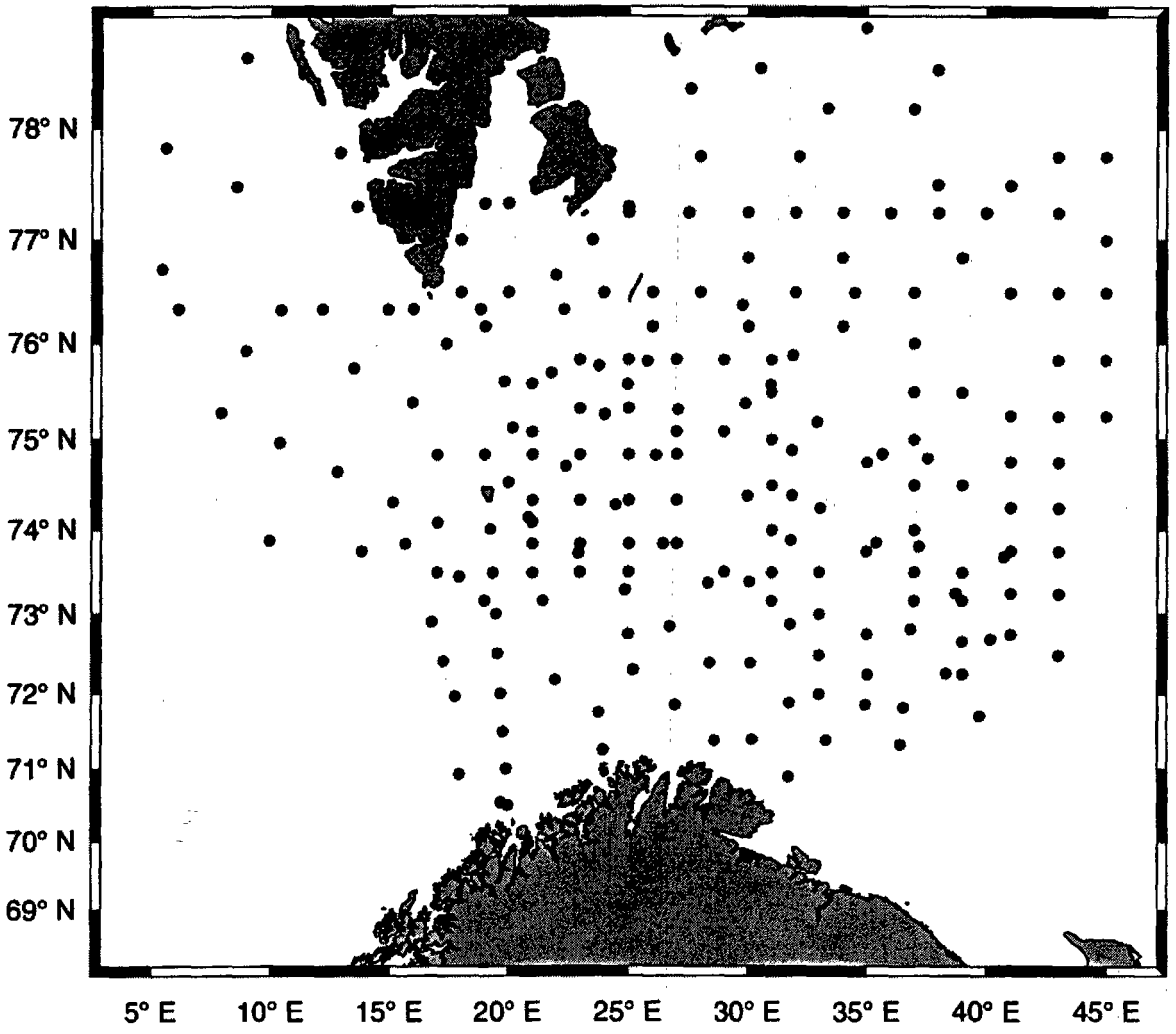

Figure 5

ANNEX 4

CHECK LIST OF PELAGIC COPEPOD SPECIES OF THE IBERO-ATLANTIC WATERS

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Abstract

Pelagic copepods cited in twenty-one collections were compared in order to produce a checklist of the species reported off the Iberian Atlantic margin. Collections were grouped in 7 different areas covering the whole continental margin. A total of 268 species were listed, 13 of which were present in all the reviewed collections. The Gulf of Cádiz and the Southern Portugal coast were by far the richest areas with 171 and 144 species respectively. Two different similarity indices were used to compare the affinity of the areas (neighbouring) based on the copepod assemblages. Results shown a clear geographical ordination suggesting a coherence in the spatial distribution of the species. Even a closer look to the collections used to study the Galicia area showed the differences between the Western and Northern part as well as among the shelf and the Rías.

Methods

The collections that were reviewed, the areas, periods of sampling and codes used in the text are showed in Table 1. Collections are far to be homogeneous in both, sampling procedures (mesh sizes, tows, depths, etc.) and seasonallity of the sampling. Thus, although the different procedures make difficult the comparison of collections, it has the advantage of offering a wider variety of species. When more than one collection was available for the same area, the species were pooled in one single inventory. Figure 1 shows the geographical coverage of the collections. Families and species were taxonomically ordinated according with Huys and Boxshall (1991), Rose (1933) and Razouls (1995). For Synonymies and authors, the recent review of Razouls (1995) was followed.

In order to have an idea of the geographical affinity among collections two different similarity indices were used (Jaccard and Kulczynski). Both indices are based in qualitative information (presence/absence). They work by comparing pairs of collections and the difference between these indices is the weight attributed to the double absences in each pair. To built the dendrogram, the UPGMA algorithm was used. The significance was tested by means of the cofenetic correlation.

Results

The studied regions has a very high species richness and up to 268 species are reported in the reviewed collections (Table 2). This richness is a consequence of the biogeography of the region, providing a mixture of species of boreal and subtropical origin. Number of species cited* ranged from 171 (Golfo de Cádiz) to 24 (San Sebastián). Only 13 species were present in all the collections, and other 9 in 6 collections (Figure 2). However these numbers understimate the coincidences because some genus (e.g., Clausocalanus, Calocalanus, Oithona, etc.) are complex and they was not identified to species level in all the collections.

The species richness decreases northwards showing a clear geographical pattern (Figure 3). This gradient is overstimated by the fact that in the northern areas the collections were taken mainly over the shelf while in the southern areas there are many oceanic stations.

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* Please note that Razouls (1995) cited around a hundred and fifty more Calanoida species in this area. Because they are cited in old collections and because we do not had access to the originals tables, these collections were not included in this review.

Similarity indices and the ordination of collections in the dendrograms also shown a geographical pattern (Figure 4). Even when the ordination is applied to the GAL collections a clear division between "shelf" and "Rías" is evidenced (Figure 5). Among the Rías, there is a discrimination between the Rías Altas and the Rías Bajas. This geographical pattern suggest a coherence in the spatial distribution of the species.

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Lakkis, S. 1967. Distribution et fluctuations quantitatives des copepodes et du phytoplancton dans la Manche et le Golfe de Gascone de 1958 a 1965. PhD Thesis, Fac. Scienc. Univ. París, 154 pp.

Moral, M. 1994. Detección de patrones de variabilidad estacional e interannual en el zooplancton de la plataforma guipuzcoana entre 1988 y 1990 y su relación con los factores ambientales. Mem. Master, Univ. País Vasco, 78 pp.

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Valdés, L. 1989. Informe sobre el zooplancton de la Ría de Puentedeume. Univ. Santiago se Compostela, Dpto. Ecología, 69 pp.

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Valdés, L., M. Roman, M.T. Alvarez-Ossorio, A.L. Gauzens and A. Miranda. 1990. Zooplankton composition and distribution off the coast of Galicia, Spain. J. Plankton Res., 12 (3): 629-643.

Table 1: List of collection used in the review

SAN SEBASTIAN	Moral, 1994	SHELF	Annual cycle	SSE
SANTANDER	Valdés y Moral, 1997	SHELF	Annual cycle	STD
ASTURIAS	Alvarez-Marqués, 1980	SHELF	Annual cycle	AST
ASTURIAS	Cabal, 1993	SHELF/OC	Annual cycle	AST
VIGO	Miranda, com.per	RIA	Annual cycle	GAL
PONTEVEDRA	Alvarez-Ossorio y Miranda, 1980	RIA	Annual cycle	GAL
AROSA	Corral y Alvarez-Ossorio, 1978	RIA	Annual cycle	GAL
MUROS	Sphor y Corral, 1976	RIA	November	GAL
MUROS	Alvarez-Ossorio, 1977	RIA	November	GAL
LA CORUÑA	Valdés, 1993	RIA	Annual cycle	GAL
LA CORUÑA	*Valdés, 199*	*SHELF*	*Annual cycle*	*GAL*
ARES	Valdés, 1989	RIA	Febr.-March	GAL
RIAS BAJAS	Alvarez-Ossorio, com.per	SHELF	June	GAL
RIAS BAJAS	Alvarez-Ossorio, 1984	SHELF	September	GAL
RIAS BAJAS	Braun *et al.*, 1990	SHELF	April	GAL
GALICIA	Valdés *et al.*,	SHELF	Jun. & Sep	GAL
FINISTERRE	Lakkis, 1967	OCEANIC	1958–1965	GAL
PORTUGAL N	Cunha, ump. Data	SHELF/OC	Annual cycle	PTG N
PORTUGAL S	Cunha, ump. Data	SHELF/OC	Annual cycle	PTG S
GOLFO CADIZ	Vives, 1975	SHELF/OC	Jun-July	GCA
GOLFO CADIZ	Graze, 1985	SHELF/OC	Aug-sep	GCA

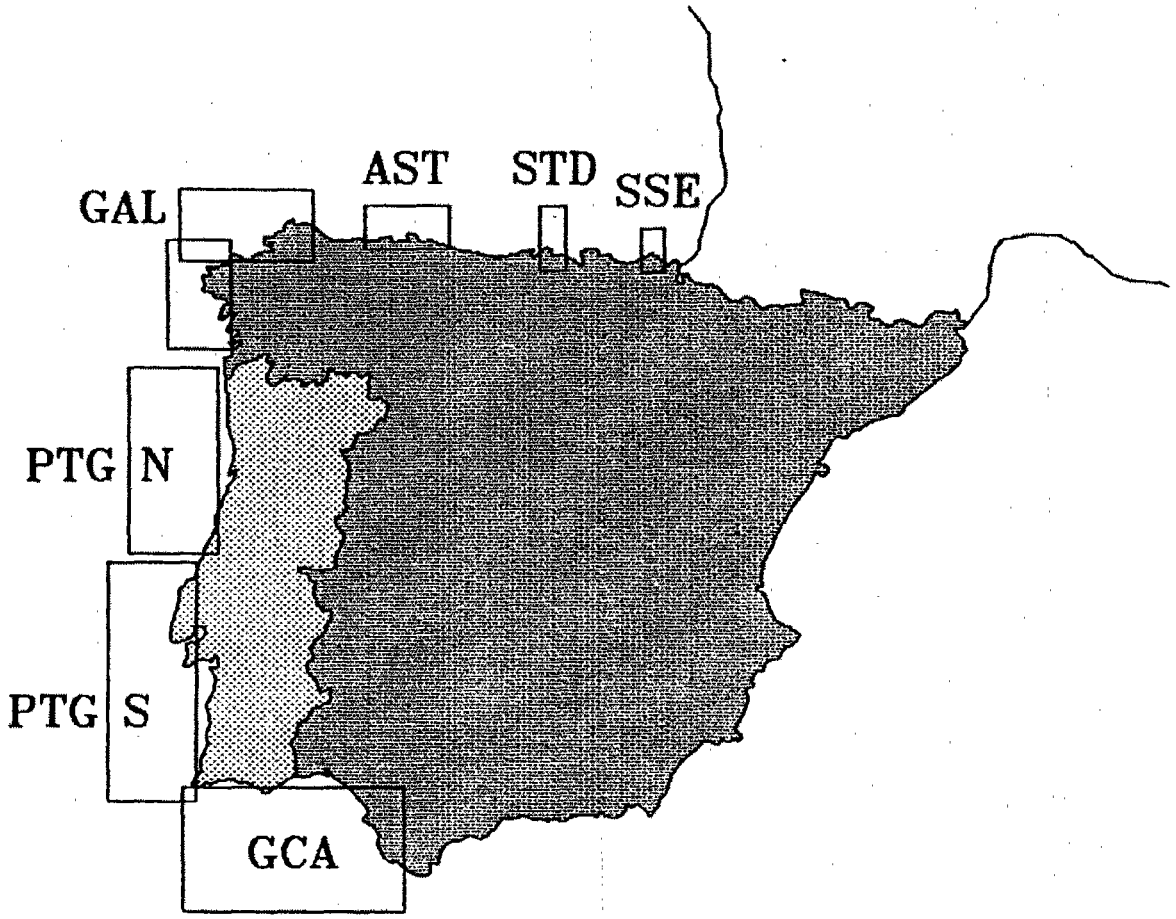

Figure 1: Map showing the area coverage of the collections reviewed.

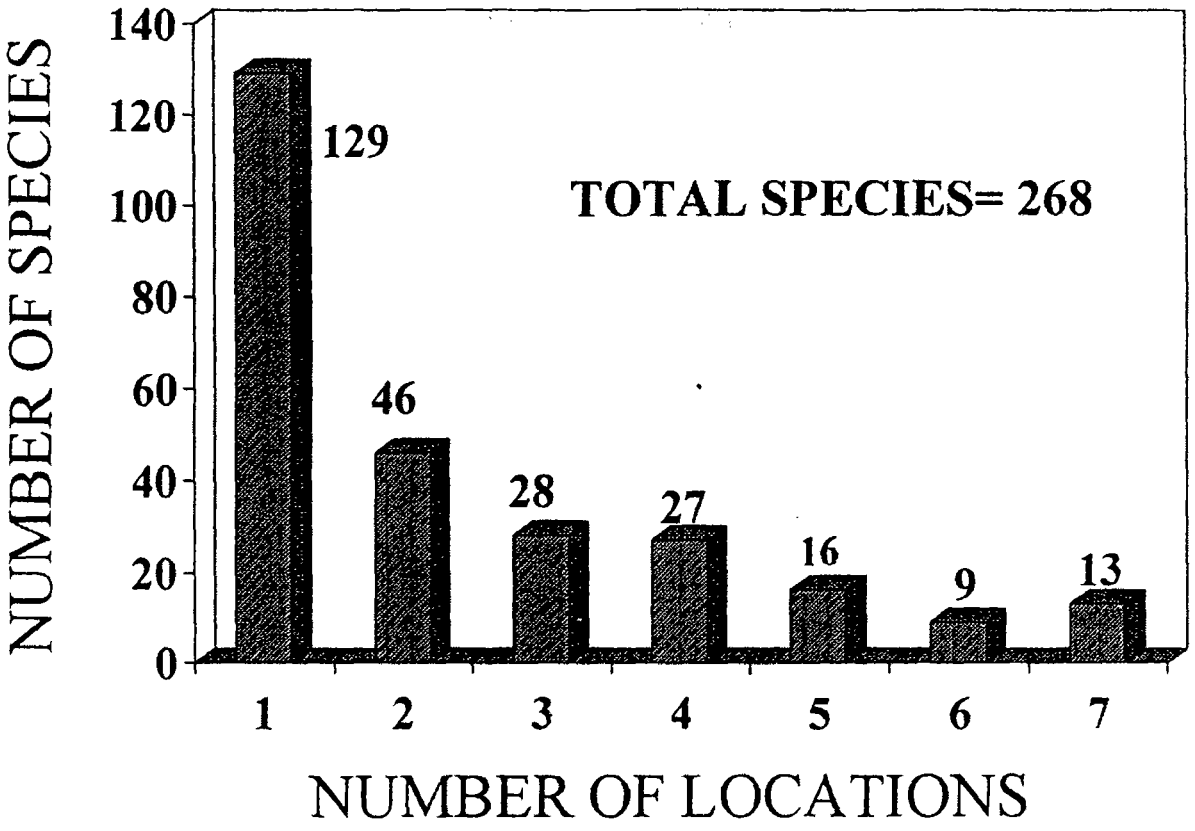

Figure 2: Classification of the species by the number of citations

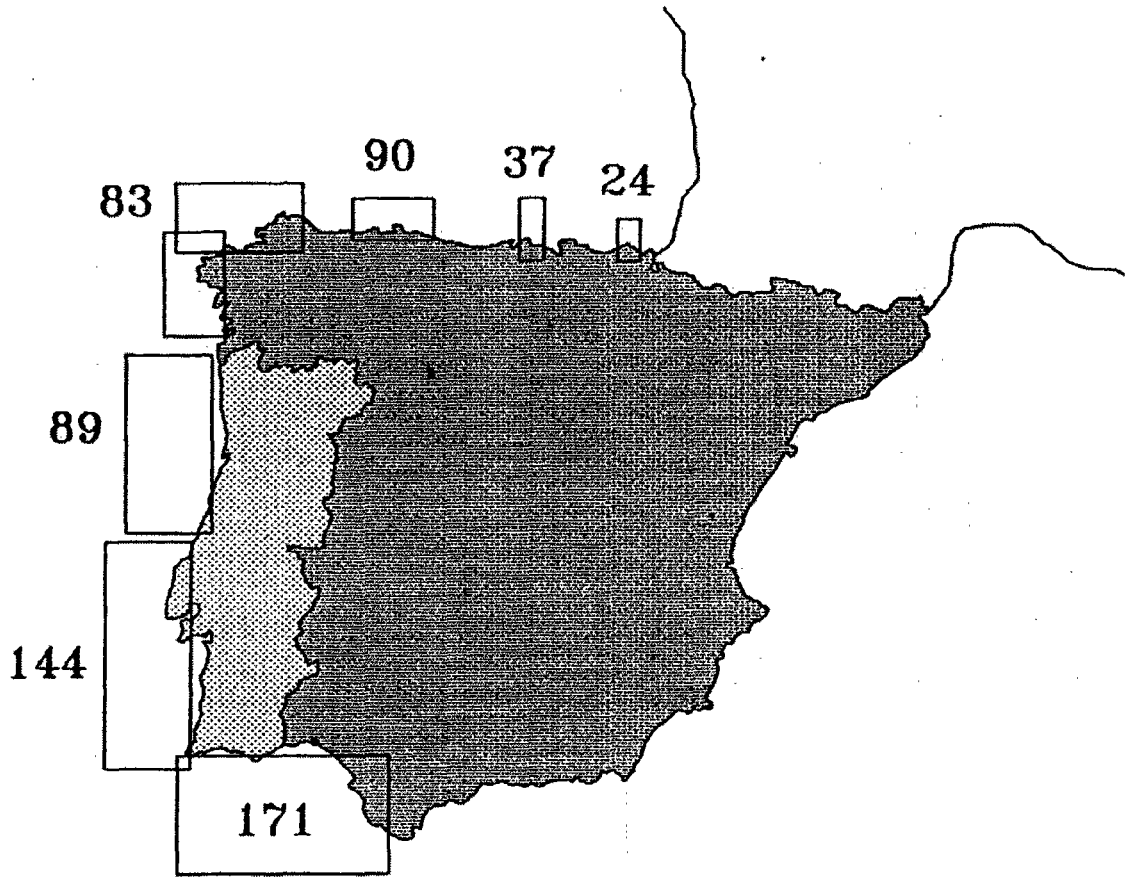

Figure 3: Map showing the geographical pattern in the number of species cited

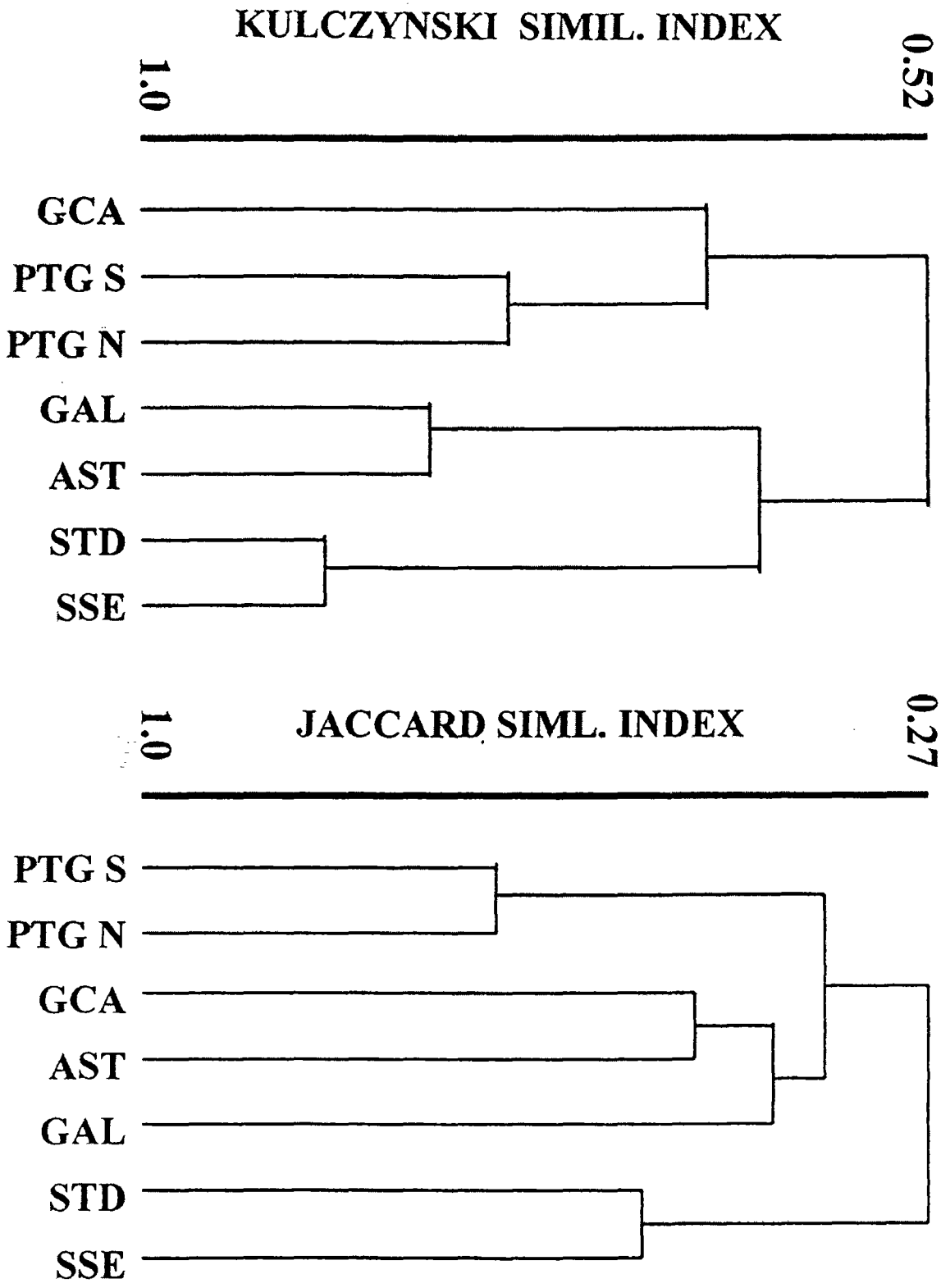

Figure 4: Ordination of collections based on the copepod assemblages

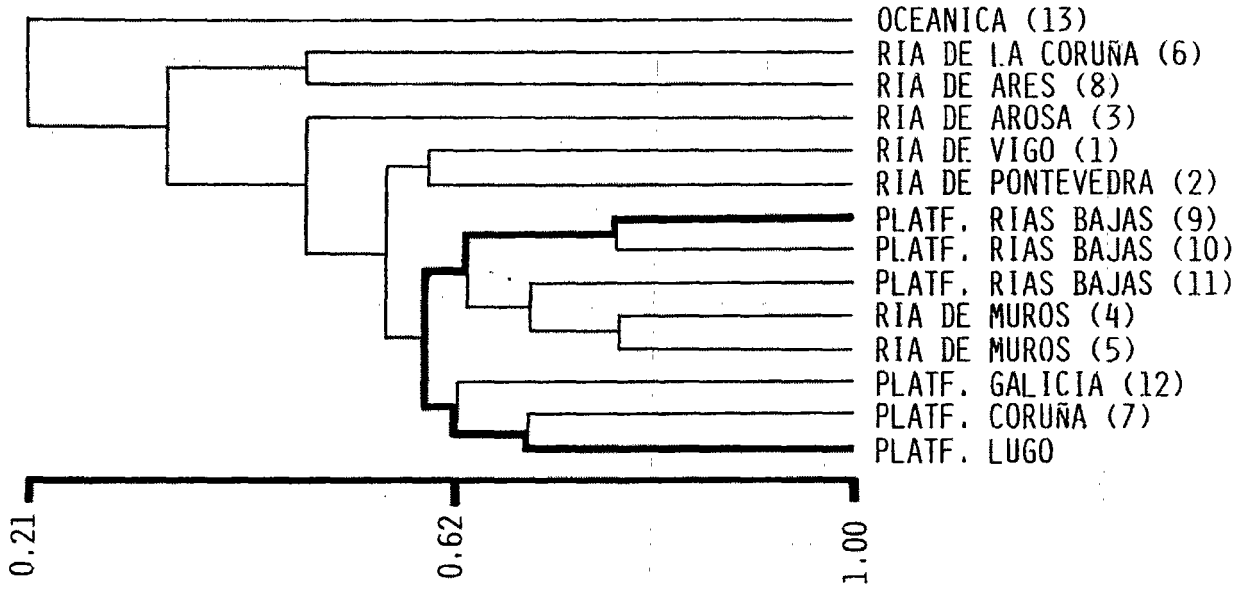

Figure 5: Ordination of collections reviewed in Galicia based on the copepod assemblages

Check list of Copepods of Atlantic Iberian waters

Orden	Familia	Especie
Calanoida	Calanidae	Calanoides carinatus (Kröyer, 1848) (Syn.C. brevicornis (Lubbock, 1856)
		Calanus finmarchicus (Gunnerus, 1770)
		Calanus gracilis (Dana, 1849) (Syn. Neocalanus gracilis (Dana, 1849))
		Calanus helgolandicus (Claus, 1863)
		Calanus robustior Giesbrecht, 1888 (Syn. Neocalanus robustior (Giesbrecht, 1888)
		Calanus tenuicornis Dana, 1849
		Nannocalanus minor (Claus, 1863)
	Megacalanidae	Megacalanus longicornis (Sars, 1905)
	Eucalanidae	Eucalanus attenuatus (Dana, 1849)
		Eucalanus crassus Giesbrecht, 1888
		Eucalanus elongatus (Dana, 1849)
		Eucalanus hyalinus (Claus, 1866)
		Eucalanus monachus Giesbrecht, 1888
		Rhincalanus cornutus (Dana, 1849)
		Rhincalanus nasutus Giesbrecht, 1888
	Paracalanidae	Paracalanus parvus (Claus, 1863)
		Paracalanus pygmaeus (Claus, 1863)
	Calocalanidae	Calocalanus altlanticus Shmeleva, 1975
		Calocalanus contractus Farran, 1926
		Calocalanus elongatus Shmeleva, 1968
		Calocalanus gracilis Tanaka, 1956 (Syn. Ischnocalanus gracilis (Tanaka, 1956)
		Calocalanus gresei Shmeleva, 1973
		Calocalanus kristalli Shmeleva, 1968
		Calocalanus latus Shmeleva, 1968
		Calocalanus longisetosus Shmeleva, 1965
		Calocalanus neptunus Shmeleva, 1965
		Calocalanus omaniensis Shmeleva, 1975
		Calocalanus ovalis Shmeleva, 1965
		Calocalanus pavo (Dana, 1849)
		Calocalanus pavoninus Farran, 1936
		Calocalanus plumatus Shmeleva, 1965
		Calocalanus styliremis Giesbrecht, 1888
		Ischnocalanus equalicauda (Bernard, 1958)
		Ischnocalanus tenuis (Farran, 1926)
	Mecynoceridae	Mecynocera clausi I.C. Thompson, 1888
	Clausocalanidae	Clausocalanus arcuicornis (Dana, 1849)
		Clausocalanus farrani Sewell, 1929
		Clausocalanus furcatus (Brady, 1883)
		Clausocalanus jobei Frost & Fleminger, 1968
		Clausocalanus lividus Frost & Fleminger, 1968
		Clausocalanus mastigophorus (Claus,1863)
		Clausocalanus paululus Farran, 1926
		Clausocalanus pergens Farran, 1926

Orden	Familia	Especie
		Clausocalanus parapergens Frost & Fleminger, 1968
		Ctenocalanus vanus Giesbrecht, 1888
		Farrania oblonga Sars, 1920
		Microcalanus pusillus Sars, 1903
		Microcalanus pygmaeus (Sars, 1900)
		Pseudocalanus elongatus (Boeck, 1865)
		Pseudocalanus minutus (Kröyer, 1845)
	Spinocalanidae	Monacilla tenera Sars, 1907
		Monacilla typica Sars, 1906
		Spinocalanus abyssalis Giesbrecht, 1888
		Spinocalanus magnus Wolfenden, 1904
		Spinocalanus parabyssalis Park, 1970
		Spinocalanus spinosus Farran, 1908
	Aetidae	Aetideopsis multiserrata (Wolfenden, 1904)
		Aetideus armatus (Boeck, 1872)
		Aetideus giesbrechti Cleve, 1904 (Syn. Euaetideus giesbrechti)
		Chiridius sp.
		Chiridius armatus (Boeck, 1872)
		Chiridius gracilis Farran, 1908
		Chiridius obtusifrons Sars, 1902
		Chiridius poppei Giesbrecht, 1892
		Chirundina parvispina (Farran, 1908)
		Chirundina streetsi Giesbrecht, 1895
		Euchirella brevis Sars, 1905
		Euchirella curticauda Giesbrecht, 1888
		Euchirella intermedia With, 1915
		Euchirella messinensis (Claus,1863)
		Euchirella pulchra (Lubbock,1856)
		Euchirella rostrata (Claus,1866)
		Gaetanus curvicornis Sars, 1905
		Gaetanus kruppi Giesbrecht, 1903
		Gaetanus miles Giesbrecht, 1888
		Gaetanus minor Farran, 1905
		Gaetanus pileatus Farran, 1903
		Gaidius affinis Sars, 1905
		Gaidius minutus Sars, 1907
		Gaidius tenuispinus (Sars, 1900)
		Undeuchaeta major Giesbrecht, 1888
		Undeuchaeta plumosa (Lubbock,1856)
		Undinopsis bradyi Sars, 1902
		Undinopsis similis Sars, 1903
	Euchaetidae	Euchaeta acuta Giesbrecht, 1892
		Euchaeta marina (Prestandrea, 1833)
		Euchaeta media Giesbrecht, 1888
		Paraeuchaeta barbata (Brady, 1833)
		Paraeuchaeta glacialis (Hansen, 1887) (Syn. Euchaeta glacialis Hansen, 1887)
		Paraeuchaeta gracilis Sars, 1905
		Paraeuchaeta hebes Giesbrecht, 1888 (Syn. Euchaeta hebes Giesbrecht, 1892)
		Paraeuchaeta norvegica (Boeck, 1872)
		Paraeuchaeta tonsa Giesbrecht, 1895 (Syn. Euchaeta tonsa Giesbrecht, 1895)

Orden	Familia	Especie
	Phaennidae	Onchocalanus cristatus (Wolfenden, 1904)
		Phaenna sp.
		Phaenna spinifera Claus, 1863
		Xanthocalanus minor Giesbrecht, 1892
		Xanthocalanus simplex Wolfenden, 1906 (Cf. Undinella)
		Xanthocalanus subagilis Wolfenden, 1904
	Scolecithricidae	Amallothrix sp.
		Lophothrix frontalis Giesbrecht, 1895
		Lophothrix latipes (T. Scott, 1894)
		Scaphocalanus angulifrons Sars, 1920
		Scaphocalanus brevicornis (Sars, 1900)
		Scaphocalanus echinatus (Farran, 1905)
		Scaphocalanus magnus (T. Scott, 1894)
		Scaphocalanus major (T. Scott, 1894)
		Scaphocalanus medius (Sars, 1907)
		Scaphocalanus subcurtus Park, 1970 (Syn. S. curtus)
		Scolecithricella abyssalis (Giesbrecht, 1888)
		Scolecithricella auropecten (Giesbrecht, 1892)
		Scolecithricella dentata (Giesbrecht, 1892)
		Scolecithricella minor (Brady, 1883)
		Scolecithricella ovata (Farran, 1905)
		Scolecithricella vittata (Giesbrecht, 1892)
		Scolecithrix bradyi Giesbrecht, 1888 (Syn. Scolecithricella bradyi)
		Scolecithrix danae (Lubbock, 1856)
		Scottocalanus australis Farran, 1936 (Cf. S. helenae)
		Scottocalanus persecans (Giesbrecht, 1895)
		Scottocalanus securifrons (T. Scott, 1894)
	Diaixidae	Diaixis durani Corral, 1972
		Diaixis hibernica (A. Scott, 1896)
		Diaixis pygmaea (T.Scott, 1899)
	Stephidae	Stephos spp.
	Tharybidae	Tharybis macrophthalma Sars, 1902
	Temoridae	Temora longicornis (Müller, 1792)
		Temora stylifera (Dana, 1849)
		Temoropia mayumbaensis T. Scott, 1894
	Metridinidae	Metridia brevicauda Giesbrecht, 1889
		Metridia longa (Lubbock, 1854)
		Metridia lucens Boeck, 1864
		Metridia macrura Sars, 1905
		Metridia princeps Giesbrecht, 1889
		Metridia venusta Giesbrecht, 1889
		Pleuromamma abdominalis (Lubbock, 1856)
		Pleuromamma borealis (F. Dahl, 1893)
		Pleuromamma gracilis (Claus, 1863)
		Pleuromamma piseki Farran, 1929
		Pleuromamma robusta (F. Dahl, 1893)
		Pleuromamma xiphias (Giesbrecht, 1889)

Orden	Familia	Especie
	Phyllopodidae	Phyllopus helgae Farran, 1908
		Phyllopus impar Farran, 1908
	Centropagidae	Centropages bradyi Wheeler, 1901 (Syn. C. violaceus (Claus, 1863)
		Centropages chierchiae Giesbrecht, 1889
		Centropages hamatus (Lilljeborg, 1853)
		Centropages typicus Kröyer, 1849
		Isias clavipes Boeck, 1864
	Lucicutiidae	Lucicutia curta Farran, 1905
		Lucicutia flavicornis (Klaus, 1863)
		Lucicutia gemina Farran, 1926
		Lucicutia longispina Tanaka, 1963
		Lucicutia lucida Farran, 1908
	Heterorhabdidae	Disseta palumboi Giesbrecht, 1889
		Heterorhabdus abyssalis (Giesbrecht, 1889)
		Heterorhabdus clausi (Giesbrecht, 1889)
		Heterorhabdus compactus (Sars, 1900)
		Heterorhabdus norvegicus (Boeck, 1872)
		Heterorhabdus papilliger (Claus, 1863)
		Heterorhabdus robustus Farran, 1908
		Heterorhabdus spinifrons (Claus, 1863)
		Heterostylites longicornis (Giesbrecht, 1889)
	Augaptilidae	Augaptilus longicaudatus (Claus, 1863)
		Euaugaptilus filigerius (Claus, 1863) (Cf. E. filiger)
		Euaugaptilus hecticus (Giesbrecht, 1889)
		Euaugaptilus magnus (Wolfenden, 1904)
		Euaugaptilus nodifrons (Sars, 1905)
		Euaugaptilus squamatus (Giesbrecht, 1889)
		Haloptilus acutifrons (Giesbrecht, 1892)
		Haloptilus angusticeps Sars, 1907
		Haloptilus longicornis (Claus, 1863)
		Haloptilus mucronatus (Claus, 1863)
		Haloptilus ornatus (Giesbrecht, 1892)
		Haloptilus oxycephalus (Giesbrecht, 1889)
		Haloptilus plumosus (Claus, 1863)
		Haloptilus spiniceps (Giesbrecht, 1892)
		Haloptilus validus Sars, 1920
	Arietellidae	Arietellus giesbrechti Sars, 1905
		Arietellus setosus Giesbrecht, 1892
	Candaciidae	Candacia aethiopica (Dana, 1849) (cf. C. ethiopica)
		Candacia armata (Boeck, 1872)
		Candacia bipinnata (Giesbrecht, 1889)
		Candacia bispinosa (Claus, 1883)
		Candacia elongata (Boeck, 1872)
		Candacia longimana (Claus, 1863)
		Candacia simplex (Giesbrecht, 1889) (Cf. Paracandacia simplex)
		Candacia tenuimana (Giesbrecht, 1889)
		Candacia varicans (Giesbrecht, 1889)

Orden	Familia	Especie
	Pontellidae	Anomalocera patersoni Templeton, 1837
		Labidocera wollastoni (Lubbock,1857)
		Pontella atlantica (Milne Edwards, 1840)
		Pontella lobiancoi (Canu, 1888)
		Pontellina plumata (Dana, 1848)
		Pontellopsis villosa Brady, 1883
	Parapontellidae	Parapontella brevicornis (Lubbock,1857)
	Acartiidae	Acartia clausi Giesbrecht, 1889
		Acartia danae Giesbrecht, 1889
		Acartia discaudata Giesbrecht, 1881
		Acartia grani (Sars, 1904)
		Acartia longiremis (Lilljeborg, 1853)
		Acartia margalefi Alcaraz, 1976
		Acartia negligens Dana, 1849
Cyclopoida	Oithonidae	Oithona decipens
		Oithona fallax
		Oithona helgolandica Claus, 1863 (Syn. O. similis)
		Oithona nana Giesbrecht, 1892 (Syn. O. minuta)
		Oithona plumifera Baird,1843
		Oithona setigera Dana, 1849
		Paraoithona parvula Farran, 1908
		Paraoithona pulla Farran, 1913
		Ratania flava Giesbrecht, 1892
	Cyclopinidae	Cyclopina littoralis Brady, 1872
Mormonilloida	Mormonillidae	Mormonilla minor Giesbrecht, 1891
Harpacticoida	Tachidiidae	Euterpina acutifrons Dana, 1852
	Ectinosomatidae	Microsetella norvegica Boeck, 1864
		Microsetella rosea Dana, 1852
	Aegisthidae	Aegisthus aculeatus Giesbrecht, 1891
		Aegisthus dubius Sars, 1916
		Aegisthus mucronatus Giesbrecht, 1891
	Miraciidae	Miracia efferata
	Macrosetellidae	Macrosetella gracilis A. Scott, 1909
	Clytemnestridae	Clytemnestra rostrata Brady, 1883
		Clytemnestra scutellata Dana, 1852
	Tisbidae	Tisbe spp.
Poecilostomatoida	Oncaeidae	Conaea rapax Giesbrecht, 1891
		Lubbockia squillimana Claus, 1863
		Oncaea bathyalis
		Oncaea conifera Giesbrecht, 1891
		Oncaea curta Sars, 1916

Orden	Familia	Especie
		Oncaea dentipes Giesbrecht, 1891
		Oncaea exigua Farran, 1908
		Oncaea infantula
		Oncaea ivlevi
		Oncaea longiseta
		Oncaea media Giesbrecht, 1891
		Oncaea mediterranea Claus, 1863
		Oncaea minuta Giesbrecht, 1892
		Oncaea neobscura
		Oncaea obscura Farran, 1908
		Oncaea ornata Giesbrecht, 1891
		Oncaea ovalis
		Oncaea prendeli
		Oncaea tenella Sars, 1916
		Oncaea subtilis Giesbrecht, 1892
		Oncaea venusta Philippi, 1843
		Oncaea zernovi
	Corycaeidae	Corycaeus agilis
		Corycaeus anglicus Lubbock, 1855
		Corycaeus brehmi Steuer, 1910
		Corycaeus clausi F. Dahl, 1894
		Corycaeus flaccus Giesbrecht, 1891
		Corycaeus furcifer Claus, 1863
		Corycaeus giesbrechti F. Dahl, 1894
		Corycaeus latus Dana, 1849
		Corycaeus limbatus Brady, 1888
		Corycaeus ovalis Claus, 1863
		Corycaeus pumilis
		Corycaeus typicus Kröyer, 1849
		Farranula carinata
		Farranula rostrata
	Sapphirinidae	Copilia (Sapphirinella) tropica
		Shapphirina angusta Dana, 1849
		Shapphirina gemma Dana, 1849
		Shapphirina iris Dana, 1849
		Shapphirina nigromaculata Claus, 1863
		Shapphirina opalina Dana, 1849
		Shapphirina sali Farran, 1929
		Vettoria granulosa (Cf. Corina granulosa Giesbrecht, 1891)
Mostrilloida	Monstriliidae	Monstrilla spp.

ANNEX 5

Preliminary list of taxonomic experts in fields related to zooplankton research.
For comments, corrections, additions etc. please contact hfock@meeresforschung.de;
Last update: 04/29/99

NAME	MAILING ADDRESS	PHONE FAX	E-MAIL ADDRESS	TAXON (LIFE STAGE)	GEOGRAPHIC AREA	TYPE OF PLANKTON
GENERAL						
dos Santos, Antonina	Instituto de Investigacao das Pescas e do Mar, Av. de Brasilia, 1400 Lisboa PORTUGAL	351- (1) 3027191 351 1 3015948	antonina@ipimar.pt	General	Atlantic	
Gómez, Milagrosa	Universidad de las Palmas de Gran Canaria. Canarias. Spain		may.gomez@biologia.ulpgc.es	General		
Head, Erica	Bedford Institute of Oceanography, P.O.Box 1006, Dartmout, N.S. CANADA B2Y 4R5	3 -(902) 426–2317	HeadE@mar.dfo-mpo.gc.ca	General		
Hernández-Leon, S.	Universidad de Las Palmas de Gran Canaria. Canarias, Spain		santiago.hernandez-leon@biologia.ulpgc.es	General		
Sameoto, Doug	Bedford Institute of Oceanography, P.O.Box 1006, Dartmout, N.S. CANADA B2Y 4R4	2 -(902) 426–3278	SameotoD@mar.dfo-mpo.gc.ca	General		
Wilson, Scott	Bedford Institute of Oceanography, P.O.Box 1006, Dartmout, N.S. CANADA B2Y 4R3	1 -(902) 426–3318	WilsonS@mar.dfo-mpo.gc.ca	General		
MISCELLANEOUS						
Boero, Ferdinando	Stazione di Biologia Marina, Dipartimento di Biologia, Università degli Studi, Ecotekne, 73100 Lecce, ITALY	I-832–320619 I-832–320702	boero@ilenic.unile.it	Hydrozoa	Mediterranean, Black Sea, Pacific	coastal
Chicharo, Luis	Universidade do Algarve, Campo de Gambelas, Faro PORTUGAL			Mollusca (Larvae)	Atlantic	coastal
Elbrächter, Malte	Litoralstation List / FIS Hafenstrasse 43 D- 25992 List, GERMANY			Protozoa, Dinophyta		
Koste, Walter*	Ludwig-Brill-Strasse 15 D- 49610 Quakenbrück GERMANY			Rotatoria		
Nuñez, Jorge	Universidad de La Laguna. Canarias.		janunez@ull.es	Polychaeta		
Ojeda, Alicia	Instituto Canario de Ciencias Marinas de Gran Canaria, Canarias, Spain		aojeda@iccm.rcanaria.es	Protozoa, Dinophyta		
Pagès, F.	Instituto de Ciencias del Mar. Barcelona. España.		fpages@icm.csic.es	Coelenterata		
CHAETOGNATHA						
Furnestin, M.L.	France			Chaetognatha		

NAME	MAILING ADDRESS	PHONE FAX	E-MAIL ADDRESS	TAXON (LIFE STAGE)	GEOGRAPHIC AREA	TYPE OF PLANKTON
Hernández-Martin, Fatima	Museo de Ciencias Naturales de Tenerife, Caranias, spain		fatima@museoscabtf.rcanaria.es	Chaetognatha		
Kapp, Helga	ZIM FIS Martin-Luther-King-Platz 3 D- 20146 Hamburg, Germany			Chaetognatha	Atlantic	
Moreno, I.	Spain			Chaetognatha		
Pierrot-Bults, A.C.	Univ. of. Amsterdam The Netherlands			Chaetognatha		
van der Spoel, S.	(SAME)			Chaetognatha		
CRUSTACEA						
Brendonck, Luc	Laboratory of Aquatic Ecology, K.U.Leuven, de Beriotstraat 32, B-3000 Leuven BELGIUM	33 (16) 323714 33 (16) 324575	Luc.Brendonck@bio.kuleuven.ac.be	Anostraca. Notostraca, Conchostraca	(East-)Atlantic	coastal
Alvarez-Marques, F.	Spain			Copepoda		
Belmonte, Genuario	Stazione di Biologia Marina, Dipartimento di Biologia, Università degli Studi, Ecotekne, 73100 Lecce, ITALY	I-832–320615 I-832–320626	belmonte@ilenic.unile.it	Calanoida, Acartiidae	Mediterranean, Black Sea	coastal
Böttger-Schnack, Ruth	Moorsehdener Weg 8 D- 24211 Rosenfeld GERMANY			Copepoda		
Boxshall, G.	UK		gab@nhm.ac.uk	Copepoda		
Bradford-Grieve, Janet M.	National Institute of Water & Atmospheric Research, P.O. Box 14–901 Kilbirnie, Wellington, New Zealand	64 4 386 0362 64 4 386 2153	j.grieve@niwa.cri.nz	Calanoida	Pacific, Atlantic	
Dahms, Hans-Uwe	Universtitaet Oldenburg/ FB Biologie, D-2611 Oldenburg GERMANY	49 (0) 441–7983369	HUDAHMS@hrz1.uni-oldenburg.de	Harpacticoida (Nauplius)		bathypelagic
Fosshagen, A.	Univ. of Bergen Norway			Copepoda		
Harding, Gareth	Bedford Institute of Oceanography, P.O.Box 1006, Dartmout, N.S. CANADA B2Y 4R2	1 -(902) 426-2692	HardingG@mar.dfo-mpo.gc.ca	Copepoda	Atlantic	coastal
Harris, R. P.	Plymouth Marine Laboratoy UK			Copepoda		
Jaume, D.				Copepoda		
Razouls,Claude	Banyuls-Sur-Mer FRANCE			Cyclopoida; Calanoida		
Sautour, B.	France			Copepoda		
Schulz, Knud	ZIM FIS Martin-Luther-King-Platz 3 D- 20146 Hamburg GERMANY			Calanoida		
Vives, F.	Spain			Copepoda		
Maria Emilia Cunha	Instituto de Investigacao das Pescas e do Mar, Av. de Brasilia, 1400 Lisboa PORTUGAL	351- (1) 3027194	micunha@ipimar.pt	Calanoida; Euphausiacea	Atlantic	
Mauchline, John	UNITED KINGDOM			Copepoda; Euphausiacea		
Anger, Klaus	BAH AWI PO Box 180 D- 27483 Helgoland Germany			Decapoda (Larvae)		
Casanova-Soulier, Bernardette	FRANCE			Euphausiacea (Larvae)	Mediterranean	

NAME	MAILING ADDRESS	PHONE FAX	E-MAIL ADDRESS	TAXON (LIFE STAGE)	GEOGRAPHIC AREA	TYPE OF PLANKTON
David V.P. Conway	Centre for Coastal and Marine Sciences, Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH, UK	44 (0)1752 633430 44 (0)1752 633100	dvpc@ccms.ac.uk	Euphausiacea	Mediterranean, Atlantic	bathypelagic, coastal
Jose Paula	Laboratorio Maritimo da Guia PORTUGAL		Jose.Paula@fc.ul.pt	Brachiura (larvae)	Portugal, Mozambique	coastal
Kobusch, Wulf	Ruhr Universitaet Bochum, Spezielle Zoologie, ND 05/776, Universitaetsstrasse 150, 44801 Bochum, GERMANY	49 (0) 234–7005577 49 (0) 234–7094114	wulf.c.kobusch@ruhr-uni-bochum.de	Mysidacea, Lophogastridae		
Lindley, Alistair	Plymouth Marine Laboratoy UNITED KINGDOM		JAL@WPO.NERC.AC.UK	Decapoda, Dendrobranchiata (Larvae)		
Tiefenbacher, Ludwig	Zoologische Staatssammlung Münchhausenstrasse 21 D- 81247 München Germany			Euphausiacea; Natantia		
PISCES						
Alemany, Francesc X.	I.E.O. Baleares			Ichthyoplankton		
John, Hans-Christian	ZIM FIS Martin-Luther-King-Platz 3 D- 20146 Hamburg Germany			Ichthyoplankton	Atlantic	
Lopes, Placida	Instituto de Investigacao das Pescas e do Mar, Av. de Brasilia, 1400 Lisboa PORTUGAL	351- (1) 3027000	lopesp@ipimar.pt	Pisces	Atlantic	
Re, Pedro	Faculdade de Ciencias da Universidade de Lisboa, Bloco-4, Campo Grande, Lisboa PORTUGAL		Pedro.Re@fc.ul.pt	Pisces	Atlantic	

ANNEX 6

Professional taxonomic expertise at the Senckenberg Research Institute relevant to Zooplankton Research

Chaetognatha

Kapp, Helga
Forschungsinstitut Senckenberg, ZIM Martin-Luther-King-Platz 3, D- 20146 Hamburg, Germany, Tel. +49 (0)40 428 38 2445, Fax +49 (0)40 428 38 3937

Calanoid Copepods

Schulz, Knud
Forschungsinstitut Senckenberg, ZIM Martin-Luther-King-Platz 3, D- 20146 Hamburg, Germany, Tel. +49 (0)40 428 38 2294, Fax +49 (0) 40 428 38 3937 email fb6a069@ rrz-cip-1.rrz.uni-hamburg.de

Please contact before sending material !

ANNEX 7

Taxonomic activities in the Canary Islands

S. Hernández-Leon

The Working Group on Zooplankton Ecology, on clarifying future actions, considers that there is an increasing loss of taxonomic experts among the zooplankton research community, and stressed the preoccupation and interest to solve this problem. Recommendations to maintain and preserve taxonomic topics within the specialised scientific community are also noted.

The need of increasing the taxonomic experts among the zooplankton research community is an urgent task to undertake serious and rigorous studies of the pelagic system and its biodiversity. Problems related to the ecology, spatial and temporal distribution and abundance cannot be met without previous understanding of the species under consideration. This knowledge will allow us to know the relevant (and target) species and how external phenomena can affect them individually and therefore, globally.

The investigation of marine biodiversity poses special scientific and conservation challenges because of the great size of, and poor access to, marine ecosystems. Moreover, the scale of marine systems and the mixing, dispersion, and transport that occur in the oceanic realm require both a different approach and new research methods. Understanding the role of biodiversity in the functioning of the ecosystem is particularly important for the conservation and management of marine systems. Fishing and removal of invertebrates and plant stocks, chemical pollution and eutrophication, physical alterations of coastal habitat, invasions of exotic species, and global climate change, including increased ultraviolet radiation and potentially rising temperatures result in possible changes to ocean circulation (and thus nutrient supply and distribution). These changes stress the marine environment affecting life (and thus species composition) from the intertidal zone to the deep sea. Natural history collections stored and maintained in a multitude of institutions are an important archiving tool for the specialists to do their research and provide the community at large with a systematic insight into species diversity and changes. The use of old collections can give us valuable insight in past and present conditions. The study of archived data is a tool to look at the future.

The samples taken over the years by the different institutions in the surroundings waters of the Canary Islands, along with the samples of other foreign research centres, have given us each day interesting surprises and has allow us to increase our knowledge about the species list, specially the deepwater. Therefore, our first main target is to contact with those local or outside researchers who carry out studies about marine biodiversity, specially those working with pelagic taxonomy. In this sense, it is of interest to coordinate the efforts made by the different researchers and institutions in the Canary Islands (Biological Oceanography Group- University of Las Palmas de GC; Planktonic Taxonomy Group- Natural History Museum of Tenerife; Planktology Group- University of La Laguna; Oceanographic Institute- Santa Cruz de Tenerife and the Canary Institute of Marine Science- Las Palmas de Gran Canaria). This would increase the knowledge of species and provide a better understanding of processes, changes and influences.

In this context, the research community at the Canary Islands is promoting an initiative on Pelagic Biodiversity centred on the study of oceanic species in the Canary Current (phytoplankton, zooplankton and neuston). Their future tasks are:

1. Undertake serious and rigorous studies of pelagic biodiversity in the waters of the Canary Current, since the pelagic system in terms of knowledge of species is one of the great unknowns and that in the case of the Canaries only a few groups have been rigorously studied (chaetognatha, copepoda).

2. Co-operation to evaluate and increase the knowledge of the existing organisms and to identify changes in the structure and functioning of the community at an early stage. This would be done in close relationship with the Globec initiative in the Canary Current.

3. To organize a working team that might gather experts on planktology in order to apply for I+D european projects.

4. To join the effort on pelagic biodiversity that the Institutions, Centres and Museums are encouraging in their global programmes and projects about marine species (ETI, DIVERSITAS, SPECIES 2000, etc.).

5. To promote workshops on taxonomy.

6. To create a data base on planktonic biodiversity of the Canary Current.

7. To elaborate the monograph PLANKTON ATLAS OF THE CANARY ISLANDS where information about the different groups can be found using high quality colour prints about pelagic fauna.

8. To teach taxonomic workers about the different plankton groups specially in the deep fauna of the Atlantic with the aim of studying several groups whose investigation is non-existent or very poor, therefore contributing to a greater knowledge of the oceanic species.

Co-ordination of these activities will be done by **Dr Fátima Hernández**. She has been investigating pelagic taxonomy since 1982, first in the Faculty of Biology at La Laguna University and afterwards at the Natural History Museum of Santa Cruz de Tenerife (Canary Islands), where she is the Curator and Head of the Department of Marine Science. She has published extensively on the collected material from the Atlantic Islands waters (Canary Islands) and she has an important bank of slides and photographs, specially on microfauna, which was created from her samples (Canary and Cap Vert Islands).

The members of the group (at present) are:

Dra. Fátima Hernández Martín (**Coordinator, Chaetognatha**). Museo de Ciencias Naturales de Tenerife. Canarias. E-mail:fatima@museoscabtf.rcanaria.es

Dr Santiago Hernández León (**Zooplankton ecology**). Universidad de Las Palmas de Gran Canaria. Canarias. E-mail: santiago.hernandez-leon@biologia.ulpgc.es

Dr Jhon Alistair Lindley (**Decapoda**). Plymouth Marine Laboratory. Reino Unido. E-mail: jal@wpo.nerc.ac.uk

Dra. Milagrosa Gómez (**Zooplankton ecology**). Universidad de las Palmas de Gran Canaria. Canarias.E-mail: may.gomez@biologia.ulpgc.es

Dr Fernando Lozano (**Copepoda**). Universidad de La Laguna. Canarias.

Dra. Alicia Ojeda (**Phytoplankton: Dinoflagelata**). Instituto Canario de Ciencias Marinas de Gran Canaria. Canarias. aojeda@iccm.rcanaria.es

Dr Francesc Pagès (**Medusae y Siphonophora**). Instituto de Ciencias del Mar. Barcelona. España. E-mail: fpages@icm.csic.es- Dr Ray Gibson (**Nemertea**). Liverpool University. Reino Unido. E-mail: r.gibson@livjm.ac.uk.

Dr Jorge Nuñez (**Polychaeta**). Universidad de La Laguna. Canarias. E-mail: janunez@ull.es.

Things to do:

April 1999	WGZE: nomination of organising committee
April 1999	local organiser: application for national funding
April May 99	organising committee: (1) draft of programme and (2) invitation of experts (3) first announcement (4) organisation of accomodation
September 99	organising committee: (1) final programme (2) correspondence with experts on their needs (optical instruments,...) (3) final announcement and call for participation
Feb/March 2000	organising committee: confirmation of participation (hopefully no selection), accomodation
until May 2000	local: final arrangements

Contact with WGZE and others, comments on programme etc. via email throughout the whole period.