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Contents

Executive summary

The ICES Working Group on Zooplankton Ecology held their annual meeting in Gdynia, Poland from 25 to 28 January 2011. The meeting was hosted by the Polish Sea Fisheries Institute. The meeting was chaired by Mark Benfield and was attended by 19 scientists representing 12 nations. The objective of the meeting was to discuss and address our eight terms of reference (ToRs) and to exchange information on recent activities in the area of zooplankton ecology from our member nations. In addition to these ToRs, we received additional ToRs from ICES after the meeting. These ToRs will be addressed in a subsequent addendum to this report as soon as time permits.

The meeting consisted of formal presentations and discussions of each ToR lead by one person and documented by a rapporteur. These interactions are summarized in the first part of this report. Additional research updates by individuals were provided at various times during the meeting and these are summarized in the second half of the report.

ToR A relates to zooplankton sorting centres. Given that our local hosts operate a sophisticated plankton sorting center (ZSIOP), we were able to learn first-hand how that centre operates and began an inventory of similar facilities in the ICES area and beyond. ToR B involved microzooplankton and activities that would increase their inclusion in WGZE activities and the Zooplankton Status Report. Since microzooplankton also fall within the purvue of the WGPME, we will hold a joint meeting with the WGPME in Malaga Spain in 2012. An inventory of potential microzooplankton time-series will also be assembled so that they can be included in future Zooplankton Status Reports. A core activity and interest of the WGZE has always been activities that advance the field of zooplankton ecology. In this spirit, a central topic of discussion (ToR C) was a new initiative to update the Zooplankton Methodology Manual and prepare videos that demonstrate methodologies that are more effectively conveyed visually. The Zooplankton Status Report continues to evolve and expand as a central repository of time-series data on zooplankton. New visual tools and metrics for enhancing the Report were summarized at the meeting (ToR D) and these will appear in future Reports. The activities of two SCOR Working Groups (WG 137: Coastal Phytoplankton Time-Series; and WG130: Automatic Visual Plankton Identification) were summarized (ToR E). Biodiversity is a term that has received widespread use and which is frequently misused. To ensure that we understand what it means and how it is measured, we received an extensive tutorial on its use and utility with respect to zooplankton (ToR F). The outcome of efforts to convene a workshop on: Cross calibration of biochemical indices of growth and validation against somatic growth rates, was summarized. Thus far attempts to fund such a workshop have not been successful but efforts continue to secure funding for this important activity. An update on the progress of the SGIMT was tabled because representatives of the SG were unable to attend the meeting.

The meeting concluded with election of a new Chairperson for the WGZE. Dr. Piotr Margonski, Poland, was unanimously elected to serve as the Chair from 2012 to 2015. The next meeting of the WGZE will be held jointly with the WGPME in Malaga, Spain, 26–29 March 2012. Dr. Lidia Yebra will be the local host.

1 Opening of the meeting and adoption of the agenda

The ICES Working Group on Zooplankton Ecology (WGZE) met at the Sea Fisheries Institute (MIR) in Gdynia, Poland from 25 to 28 January 2011. Our local host was Dr. Piotr Margonski of MIR. The meeting was attended by 19 scientists representing twelve nations (Annex 1).

Mark Benfield (Chair) opened the meeting at 09:00 and welcomed the members and guests of the group to Gdynia. Following a round of introductions, the group was welcomed by Piotr Margonski who summarized logistical details of the meeting.

The agenda for the WGZE meeting (Annex 2) followed the Terms of Reference adopted as a resolution by the ICES 2010 Annual Science Conference and Statutory Meeting. The agenda had been circulated amongst the working group membership prior to the meeting and incorporated most suggestions and comments. Last minute adjustments were discussed and the agenda was adopted by unanimous vote. The Terms of Reference for this meeting are to:

a) Identify current zooplankton sorting centres and laboratories and prepare a review of their services, costs, and taxonomic expertise;

b) Build on the work relating to microzooplankton completed in Riga (2007) and explore the extent to which microzooplankton could be included in the zooplankton time-series produced in the Plankton Status Report;

c) Prepare a report on updating the Zooplankton Methodology Manual including identifying areas of the manual that require updating and activities that lend themselves to multimedia tutorials (e.g. videos) to be served via the web;

d) Review the Zooplankton Status Report and consider further developments and improvements to its contents including new time-series and additional analyses;

e) Review the outcomes of SCOR 137 (Coastal Phytoplankton Time-Series) and SCOR 130 (Automatic Visual Plankton Identification) and summarize findings relevant to zooplankton ecology;

f) Define the meaning of the term 'biodiversity' with respect to zooplankton including its definition, measurement, and relevant indices based upon it;

g) Review the progress towards the workshop: Cross calibration of biochemical indices of growth and validation against somatic growth rates;

h) Review the progress of the SGIMT.

2 ToR A: Identify current zooplankton sorting centres and laboratories and prepare a review of their services, costs, and taxonomic expertise

Lead: Piotr Margonski, Rapporteur: Klas Ove Möller

Mark Benfield gave a short introduction of the topic and pointed out the need, to get a review and a register of Plankton Sorting centres, worldwide. He encouraged all participants to assemble data of known Institutes and experts with the goal to establish a list of these Institutes and taxonomists as well as their existing techniques (e.g. DNA sequencing and FlowCam), since the need for taxonomic identification of Plankton samples is increasing steadily, but those institutions and experienced taxonomists are getting more and more rarely.

Following this, Piotr Margonski started a presentation of the Plankton Sorting and Identification Centre in Szczecin that is affiliated to the Sea Fisheries Institute in Gdynia. Two employees of the Sorting Centre attended the meeting to answer potentially upcoming questions of the group.

The Sorting centre was founded in 1974 following the signing of an intergovernmental agreement between the Sea Fisheries Institute in Gdynia and the NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory in Massachusetts, USA. The Plankton Sorting and Identification Center analyzes approximately 7000 samples annually within the framework of regular contracts.

The department provides scientific and technical services for the analysis of plankton samples using methods proposed by the contracting party. The laboratory currently offers a wide range of services for the taxonomic identification of different types of plankton samples as well as for determining size and biological structure and it comprises three laboratories:

- Plankton Sorting Laboratory: specializes in sorting samples and identifying CPR samples;
- Fish Taxonomy Laboratory: specializes in taxonomic identification of fish and classifying fish eggs by development stage; and
- Zooplankton Ecology Laboratory: specializes in marine invertebrate taxonomy.

The Centre's main expertise is focusing on the Northern Atlantic Ocean including the adjacent Shelf sea as well as the North-West coast of the United States .

The SFI Plankton Sorting and Identification Center in Szczecin is currently cooperating with the following American NOAA/NMFSC centers:

- NOAA-NMFS, Northeast Fisheries Science Center, Narragansett Laboratory, RI, contacts: Ken Sherman & Jon Hare
- NOAA-NMFS-SEFSC, Southeast Fisheries Service, Mississippi Laboratories, Pascagoula, Baton Rouge, Biloxi, Ocean Springs, MS, contact: Joanne Lyczkowski-Schultz
- NOAA-NMFS, Alaska Fisheries Science Center, Resource Assessment and Conservation Engineering Division, Seattle, WA, contacts: Ann Matarese & Jeff Napp
- Dauphin Island Sea Laboratory (DISL), Dauphin Island, AL, contact: Frank Hernandez

Current Non-USA clients include Institutions and Universities from Denmark, Sweden, Netherlands and the United Kingdom while previous clients came from across the whole North American and European continent.

Piotr showed some example sheets explaining the counting criteria and the taxonomic sample procedure which are pre-decided between the client and the sorting centre. The Laboratory analysis include:

- taxonomic classification of ichthyoplankton, zooplankton, and phytoplankton;
- measuring invertebrates and fish larvae;
- identification of plankton in ballast water;
- classifying eggs by development stages;

- determining the numbers of zooplankton dominants; and
- determining the food composition of fish larvae.

The cost of sample analyses varies depending on the:

- volume of samples analyzed;
- number of organisms sorted;
- analysis and categorization of organisms by development stages;
- organism measurement requirements as stipulated by contracting party;
- contracting party requirements for data processing electronic documents.

Piotr Margonski's presentation of the sorting centre was followed by a lot of questions and a lively discussion of the group. Peter Wiebe asked if there is a "depth-limit" and if the taxonomists have any experience with samples out of greater depths or some kind of Deep-sea expertise. Wanda Kalandyk (Head of Sorting Centre) answered, that they have not worked on Deep-Sea samples so far, but would be able accomplish that after being trained by some experts. Mark Benfield asked if the processed samples are quality controlled whereupon Piotr answered, that quality control samples are analysed, labelled and results are returned for checking.

Peter Wiebe mentioned that barcodes might be an appropriate technique to help identify some species since the technique should be feasible and available in many laboratories soon. Mark Benfield mentioned the problem that young taxonomist and qualified trainees are missing and pointed out the need for continuity and young experts especially for processing samples from time-series that need to have a certain standard. This seems to be a common problem since Sophie Pitois reported the same from her Institute and Peter Wiebe presented a journal article called "Extinction of taxonomists" that also dealt with this issue. Mark Benfield asked the group to start carrying together informations of known experts, groups of taxonomists and sorting centres.

Klas Möller knows a group in Germany that has a broad expertise and is at the moment doing a quality check of the first samples he has sent there for ground-truthing and comparison. Roger Harris mentioned a group at his Institute that is mainly focussing on CPR sample analysis and Tone Falkenhaug knows from some experts for certain taxa in Norway and a group in Moscow/ Russia. Lutz Postel announced that the analysis of the Helgoland Road time-series, that was formerly processed by the group of Wulf Greve is momentary stopped, but will probably be continued within a new project. Fortunately, the Helgoland samples are still collected.

Lutz also highlighted that it is important to distinguish between routine work, which is mainly focussing on one area, and expert work that is combined with special knowledge of a certain taxon. Lidia Yebra referred to the group of Xabier Irigoien who have an expertise for Fish larvae and eggs. Mark Benfield proposed that politics might also be a problem for this topic since he heard of a senator who restricted an institution to send its samples for analysis to Poland and wanted them to be processed inside the United States. Mark provided the example of the Gulf of Mexico, which is a high-interest area since the oil spill last year and there are many samples that need to be processed, but it takes a lot of time and especially money to get a group of taxonomist established.

He announced a document that will be set up after the meeting and send out to all members of the WGZE where groups of taxonomists or professional sorting centres should be inscribed to get an worldwide overview of taxonomic expertise and possi-

bilities where plankton samples can be send to. The results of this survey would be made available at the 2012 meeting.

3 ToR B: Build on the work relating to microzooplankton completed in Riga (2007) and explore the extent to which microzooplankton could be included in the zooplankton time-series produced in the Plankton Status Report

Presenter: Mark Benfield

The importance of microzooplankton in marine ecology is increasingly receiving recognition. At the same time, this critical assemblage has not been well represented within the WGZE's expertise nor has it been considered a full part of any phytoplankton working group. With the inception of the new phytoplankton and microbial ecology working group (WGPME), there is an opportunity to foster greater linkages between colleagues in the WGZE and WGPME to ensure that microzooplankton receive the attention that they clearly merit. Moreover, the Zooplankton Status Report provides an opportunity to summarize microzooplankton time-series that would complement the existing mesozooplankton and associated hydrographic and climate data already in the report.

As a first step towards ensuring the microzooplankton are included in the activities of the WGZE and to foster closer interactions with colleagues in the WGPME who work on microzooplankton, we proposed to hold a joint meeting with the WGPME in 2012. This idea was proposed to the chairpersons of the WGPME. Both Bill Li and Xelu Moran were very supportive of this proposal and at their annual meeting, the members of the WGPME formally accepted an invitation to hold a joint meeting with the WGZE in Malaga, Spain from 26 to 29 March 2012.

In terms of adding microzooplankton to the Zooplankton Status Report, Todd O'Brien indicated that this was quite feasible. The first step will be to assemble an inventory of microzooplankton time-series that may be available. This topic will be addressed at the joint meeting in 2012.

4 ToR C: Prepare a report on updating the Zooplankton Methodology Manual including identifying areas of the manual that require updating and activities that lend themselves to multimedia tutorials (e.g. videos) to be served via the web

Presenter: Roger Harris; Rapporteurs: Hogni Debes and Elaine Fileman

Roger started by giving a short introduction/history of the working group, and then talked about one of the major achievements of the group: The Zooplankton Methodology Manual (Manual). This manual took several years to complete. The group agreed on that the Manual might be a bit out of date on some areas, and might need updating.

At the 2010 meeting in Portland, the plan was to approach the publisher about the possibility of producing a paper-back edition of the existing manual. This might be a cheap way to update the existing manual. There were suggestions of producing PDF documents of each chapter, but this was not considered an option.

Other ideas were: (1) review the content of the existing chapters in the manual, and come up with a review article update of selected topics; (2) prepare a CD-ROM; prepare a list of potential videos that might be made, people who might be approached, and suggest a web-based way of organizing and developing this project.

Prior to the meeting, Jeff Runge, Roger Harris and Peter Wiebe evaluated each chapter regarding need for an update. Their conclusion was that more or less all chapters need some update, some more than others. In the discussion of content for an update of the Manual: Elaine suggested including a molecular chapter in the ZMM; Peter mentioned that environmental barcoding is a significant advance for identifying what is in the water column; for chapter 9 (Growth and Reproduction), Jeff suggested including Lidia Yebra as an author. Roger suggested including a chapter on behaviour, as well as including mortality or population dynamics. For chapter 10 (Metabolism), Jeff suggested including oxygen consumption, as well as growth rate and enzymatic methods. Additional topics for a 2nd Edition of the Manual were: statistical analysis of time-series; behaviour of zooplankton; Imaging Techniques (e.g. ZooScan, ZooImage, RAPID); and Gear Intercomparisons.

There was a great deal of discussion on this ToR. Roger Harris stressed the need for a real engagement from the group to produce a new manual. Peter Wiebe agreed on this and argued for the need of a core-group of people to make it happen, and that if we start now the challenge should be to have it finished by 2015. Roger then brought up again the idea of producing a review article, highlighting certain topics of advances in the field, and have it published. After this, the discussion mostly focused on this topic.

Mark Benfield suggested producing a series of review articles on advances in the different fields. Lidia Yebra agreed that this was a good idea, but suggested to have them broken up in chapters like in the book. Mark Benfield mentioned the need for a timeline to do the update. Roger Harris mentioned that the publisher needs to know if we are going for a 2nd Edition (paperback) of the original Manual.

Mark Benfield mentioned that we might need permission from the original authors for revising the manual (chapters). Doing an update of the original ZMM will depend on the slowest group (need to produce all chapters before publishing the 2nd edition), while publishing a series of papers would avoid this problem. Elaine pointed out that having two editions of the ZMM might cause confusion. Lidia mentioned the possibility of publishing the updated manuals as open access, so everyone has access to it. Lutz Postel suggested producing collective reprints. He also suggested making the manuscripts available on the WGZE website for everyone to cite and comment. Roger again mentioned that if we were to update the book, we need to contact the publisher, and thus more work would be needed. Mark mentioned that if we were to go for a series of papers, we need to agree on authors and a series editor.

Roger added that we need the same information for both alternatives. He also mentioned that we need to agree on which topics, how many topics, and who to write them

The next day we continued the discussion of this ToR, this time focusing on videos. The aim of this discussion was to compile a list of potential videos, which could be used to complement the Manual. The videos could be made widely available via the Internet, (specifically via the WGZE website) and be used to demonstrate zooplankton sampling techniques. These videos would illustrate topics that are difficult to effectively convey in print and would be useful for students and as a teaching aid. As an action item, Todd O'Brien will look into how videos could be uploaded onto WGZE website.

It was proposed that there would be one common theme video that all groups who would like to participate in the task could contribute to and a number of individual projects, which would be assigned to one or more project team(s). Eight members of

the group volunteered to take part in this task – Peter (Team WHOI), Tone (Team IMR), Maiju & Elena (Team Finland & Sweden), Klas (Team Hamburg), Karl (Team Belgium), Mark (Team LSU), Elaine (Team PML), and Piotr (Team Poland).

The common video would be a demonstration of effective sampling gear deployment and recovery (e.g. bongo nets, WP2 nets, MOCNESS, CPR or whichever gear you use to collect zooplankton samples).

A number of individual video projects were decided upon:

Project 1: Sampling, washing nets, sample into jars, labelling etc – Team PML, Hamburg & Norway, Team Finland/Sweden

Project 2: Flow meters etc – Team LSU

Project 3: Making up preservative & buffering – Team SAHFOS

Project 4: Demonstrate splitting techniques & subsampling – Team WHOI, Team Finland/Sweden

Project 5: Egg production experiments – Team SAHFOS

Project 6: Seawater dilution experiments – Team PML

Project 7: Silhouette photography – WHOI, LSU

Karl volunteered film footage of zooplankton sampling techniques made by a professional film company in Belgium. Karl will email the link to these videos to the rest of the group so that they can view videos and decide whether they can be used instead of making new ones.

The videos should be no more than 3 minutes long. Any background noise should be removed and replaced with a suitable voice over or if using music be sure to get rights for the music – watch out for copyright. Timescale – videos should be ready to show at the next group meeting in 2012. It was suggested that they be filmed perhaps over the summer, do not leave until the last minute. Once clips are available please inform Todd so that they can be put onto the WGZE website for viewing and comments from others in the group. The whole process should be an iterative one so that when we come to meet again next year each video will be more 'polished'!

Peter W asked whether we should have a standard structure. Mark will put together a PowerPoint slide showing common title template which shows ownership by the WGZE, standard titles and credits.

Mark recommended that those involved in making videos take a look at a book by Randy Olsen entitled 'Don't be such a scientist' – worth a read. He also stressed that everyone should shoot lots of video footage and recommended a digital SLR with various lens options e.g. wide angle. Peter showed a short video clip on how to deploy a MOCNESS.

5 ToR D: Review the Zooplankton Status Report and consider further developments and improvements to its contents including new time-series and additional analyses

Presenter: Todd O'Brien

The "2008/2009 zooplankton status report" is the eighth report on zooplankton monitoring prepared by WGZE. With a comprehensive report being created by WGZE every other year, each report strives to introduce new data content (e.g. number of

sites reporting as well as the breadth of data types included) as well as adding new analyses and visualizations of these data. New for the 2008/2009 report, each of the major geographic regions (e.g. "the northwest Atlantic", "the Baltic Sea", "the North Sea") included an extended regional introduction and summary. This introduction, followed by the individual monitoring site summaries found in that section, provides an overview of the general state and trends seen across that entire region. These introductions commented on topics ranging from invasive species to general changes in community composition and/or major hydrographic changes seen in the regions.

At the time of the January WGZE meeting in Poland, the 2008/2009 ICES Zooplankton Status Report was still in editorial preparation. This report is now available online (http://ices.dk/products/cooperative.asp) as ICES Cooperative Research Report No. 307.

WGZE also discussed new analyses and future status report ideas, focusing mainly on the inclusion of zooplankton species and group abundances and composition data. While a basic form of this data was provided in earlier reports in a table form, it was found that a simple "species-over-time" line plot created by Tone Falkenhaug showed conveyed the data better in most cases. This type of plot will be further developed and included as a standard result figure in the next zooplankton status report (2010/2011).

The COPEPOD Interactive Time-series Explorer (COPEPODITE) toolkit, available online at http://COPEPODITE.org , was introduced to the group. Part of the Coastal & Oceanic Plankton Ecology, Production, & Observation Database (COPEPOD) project, this free, online tool allows any investigator to apply their own data and instantly create the graphics and analyses seen in the ICES Zooplankton Status Report series.

6 ToR E: Review the outcomes of SCOR 137 (Coastal Phytoplankton Time-Series) and SCOR 130 (Automatic Visual Plankton Identification) and summarize findings relevant to zooplankton ecology

Presenters: Todd O'Brien (SCOR 137) and Mark Benfield (SCOR 130)

SCOR Working Group 137 (Global Patterns of Phytoplankton Dynamics in Coastal Ecosystems) is a new global phytoplankton time-series working group which held its first meeting in Zhanghou, China, in October of 2010. WG137 is a global counter-part of the ICES WGPME (Working Group on Phytoplankton and Microbial Ecology), and will work in cooperation with this group and its members. Todd O'Brien is providing time-series data and analysis support for WG137 and WGPME (and WGZE), sharing the COPEPOD time-series analysis and visualization tools across all three groups.

Initial comparisons of WG137/WGPME phytoplankton time-series data with the existing WGZE zooplankton time-series collection show some interesting differences. The most notable difference is that the phytoplankton time-series sites tend to be near shore (versus the off-shore, continental shelf monitoring of many zooplankton sites). These closer sampling locations often facilitate more frequent phytoplankton sampling (e.g. weekly vs. monthly or alternate months) and the operation of more monitoring sites along the coast line. The second most notable difference is the presence of *in situ* temperature, nutrient, and chlorophyll data with almost all of the phytoplankton monitoring data. (These same data are not available at many of the zooplankton sites, and in many cases can now be acquired through the WGPME efforts.) These

differences of higher sampling frequency, with more sites and more variables means that the raw volume of phytoplankton data has already matched or surpassed that of the WGZE work in many regions.

The greatest expected benefit from WG137/WGPME work for the WGZE group is the development of new species and community level analysis (within the phytoplankton community) which can be applied to the zooplankton species data.

SCOR Working Group 130 (Automatic Visual Plankton Identification) will conclude its four-year term with a wrap-up meeting during the Zooplankton Production Symposium in Pucon, Chile (14–18 March 2011). The WG is jointly chaired by Phil Culverhouse (Plymouth University) and Mark Benfield (Louisiana State University). The terms of reference for the WG are:

- To encourage the international co-operation of software developers and marine scientists to use and enhance an appropriate open-source development platform, so that a common toolset can be built up over time that is of value to the community;
- To evaluate the limits of taxonomic resolution possible from image-based classifiers and develop means of improving the taxonomic resolution that can be achieved from plankton images. The working group will establish a basis for standards in taxonomic reporting by automatic labelling instruments;
- To review existing practices and establish standards in the use of reference image data used for training automation machines and in training people;
- To establish a methodology for inter-comparison/calibration of different visual analysis systems; and
- To develop open-source software for application by the marine ecology, taxonomy and systems developers.

The group has been operating since 2007 and has held annual four meetings, in Hiroshima Japan, Sao Paolo Brazil, Baton Rouge USA and Villefranche France. Meetings have always included presentations from commercial hardware developers (Flowcam, Zooscan, UVP), open-source software developers (Plankton identify, Zooimage, matlab toolkit, PICT and PAS) and also end-users from a variety of marine laboratories in addition to members and associate members of Working Group 130. The mix of backgrounds has made for interesting discussions and over time fostered collaborations across these diverse fields. So, as a direct result of the formation of WG130 all the laboratories below have established strong links: Louisiana State University, Department of Oceanography and Coastal Sciences; Centre for Robotics & Neural Systems, University of Plymouth; Department of Biology, Woods Hole Oceanographic Institution; Numerical Ecology of Aquatic Systems, Mons University, Belgium; Biological Oceanography, Marine & Coastal Management (Research, Antarctica and Islands), South Africa; Department of Palaeontology, The Natural History Museum, UK; CNRS/UPMC, LOBEPM, Villefranche sur mer, France; Marine Scotland, Marine Laboratory, Zooplankton Ecology Group; Instituto Oceanografico, Universidade de Sao Paulo, Praça do Oceanografico São Paulo, Brazil; Shirshov Institute of Oceanology, Russian Academy of Sciences, Russia; Optics Department, Division of Applied Physics, CICESE, Mexico; Stazione Zoologica 'Anton Dohrn' Napoli, Italy; Bigelow Laboratory for Ocean Sciences, USA; Centro Oceanográfico de Gijón, Instituto Español de Oceanografía, Spain; AZTI (Institute for Fisheries and Food Science), Spain; JAMSTEC, Japan; Institute of Oceanology, Chinese Academy of Sciences, PRC;

Plymouth Marine Laboratory, UK; Sir Alistair Hardy Foundation for Ocean Science, Plymouth UK; INIDEP, Mar del Plata, Argentina.

The links have been forged through meetings; join publications and joint research experiments between WG130 members, associate members and guests to WG130 meetings. This represents a significant proportion of the research community in the domain of computer-based visual identification of plankton.

In terms of evaluating the limits of taxonomic resolution for image classification systems, it is still early days to be definitive in terms of taxonomic resolution, a number of papers have already been published that demonstrate the resolution of image-based plankton identification.

The ToR on reviewing existing practices and establishing reference image databases has also been addressed in two stages. The first report was tabled to SCOR in 2008, the second and final report was completed and included in the 2010 report. Also It has been published on the SCOR WG130 website. The recommendations of this subgroup are a set of plankton taxa that can be monitored using automatic means, and also those that need to be monitored, and for which standard type-specimen collections must be established. Gorsky and others at LOV are constructing an archive of vignettes taken from Zooscan-processed samples. These are archives are available as training sets for other Zooscan users. The Ocean Weather Station India samples are being processed in the same manner and will also form a reference data set in the future.

To establish a methodology for inter-comparison/calibration of different visual analysis systems, we now have established both a set of experiments to explore inter-calibration between instruments, but also to define the relationship between machine performance and human performance. Some of these experiments have been delayed by difficulties experienced in transporting plankton across international boundaries, as described above. However, we now are in a position to describe inter-calibrations between FlowCAM instruments through the use of Zoo/PhytoImage, and between a high resolution digital camera, a scanner with ZooImage and Zooscan using Plankton identify.

There have been seven inter-calibration papers published since 2003 (see Table 1), All except two have been authored by at least one SCOR WG130 member. Four reviews have been published in this period; all were senior authored by SCOR WG130 members except Morales (2008), who cites the need for automation to cope with the decline of taxonomists in South America. There is also a trend in publications of increasingly large-scale studies, with one global-scale publication in 2008 (Stemmann *et al.* 2008). We can expect more of these extensive studies in the future.

year	total per annum	techniques	intercalibration	local studies	large studies	global studies	reviews	SCOR WG130 members
2003	10	4	1	5				5
2004	6	4		2				2
2005	5	4			1			3
2006	6	3		2			1	3
2007	12	8	1	1	3		1	5
2008	12	5	1	2	3	1	1	5
2009	15	5	2	3	4			10
2010	16	10	2	1	2		1	12

Table 1: Publications relating to automatic plankton identification 2003-2010

The development of open-source software has advanced. There are two truly open-source software toolkits being distributed at present: Zoo/PhytoImage (Gosjean *et al.*

2004, for example) & ZooProcess/Plankton identify (Gorsky *et al.* 2010, for example). Both groups acknowledge that metadata is the most important facet of a sample that can form the basis of a common exchange format, both are contributing to the discussions on metadata and standards. It is also acknowledged that the DarwinCore2 metadata definition addresses many of the issues required of an exchange format. Both software toolkits offer links to a range of input devices, including flat-bed scanners, digital cameras, FlowCAM, Zooscan and UVP for example. A number of SCOR WG130 members and associate members have had published, or plan to publish, inter-calibration and performance issues of these.

Four reviews have been published since 2003 (see Table 1); all were senior authored by SCOR WG130 members except Morales (2008), who cites the need for automation to cope with the decline of taxonomists in South America. The first review gave rise to the Research in Automatic Identification of Plankton (RAPID) group, a precursor to SCOR WG130. There is also a trend in publications of increasingly large-scale studies, with one global-scale publication in 2008 (Stemmann *et al*. 2008). We can expect more of these extensive studies in the future.

Review articles offer a way of promoting new ideas and methods in an easily digestible form for people new to the field. We report that Culverhouse *et al.* (2006) has been cited 16 times, and Benfield *et al.* (2007) has nine citations with all citations being to new authors. The groundbreaking Tara Oceans Project (http://oceans.taraexpeditions.org) identifies both reviews as defining the requirements of automation. It is too early to assess the impact of Sieracki *et al.* (2009). In her review of Plankton monitoring and analysis in the oceans, capacity building requirements and initiatives in Latin-America, Morales (2008) places computer-based visual identification of plankton into the context of South American marine ecology. Three papers cite SCOR WG130 in their acknowledgements. The working group has also held a special session of the Summer ASLO/NABS meeting

The editors of Nature invited the working group to submit an opinion article on automatic identification (MacLeod, Benfield and Culverhouse, 2010). This article acknowledges the value of SCOR WG130 in bringing a group together to collaborate on a new technology theme and developing it over a period of time.

We acknowledge the delays in getting experimental work completed and analyzed in time for an expected JPR publication in 2010. However, we are still in discussions with the editor of JPR on a special issue call. We are also in discussions with book publishers. Finally the WG130 were invited to plan a conference one-day workshop on computer-based visual identification of plankton at the Zooplankton Productivity Meeting to be held in Pucon, Chile in March 2011. This has been delivered and reported above.

In conclusion, the Working Group has taken time to bond and become productive, but now it is cohesive. The members are becoming clearer in the needs of the wider community and we expect the Nature paper, the JPR special issue, the ZPS meeting in Pucon and discussions with a book publisher to continue to raise the profile of computer-based visual identification of plankton. A strength of the group is that we represent both commercial and low cost methods for automation, which will give both government laboratories and university laboratories in developed and developing countries access to the same quality of computer tools.

7 ToR F: Define the meaning of the term 'biodiversity' with respect to zooplankton including its definition, measurement, and relevant indices based upon it

Presenter: Lutz Postel; Rapporteur: Mark Benfield

Lutz presented a summary of how biodiversity is defined with particular relevance to zooplankton. He then summarized the information provided by various biodiversity indices. Omori and Ikeda (1984) defined biodiversity as the degree of complexity in a community. Although species are usually the focus, the concept of biodiversity has also been used for genetic and ecosystem diversity. The term biodiversity is often misused and overused.

A paper titled "How diverse is aquatic biodiversity research?" by Moustakas and Karakassis (2005) published in Aquatic Research provides a summary of the number of publications that refer to biodiversity and the number or organisms in particular phyla or higher taxa. This summary was valid to 2001 but it illustrates that for many taxa (e.g. Platyhelminthes, Gastrotrichs, Nermertines), the limiting factor in addressing their biodiversity seems to be a paucity of taxonomists. Lutz also contrasted differences in the taxonomic background for fresh and marine areas. For example, marine plankton are summarized by seven volumes of Nordisches Plankton whereas a single freshwater volume (Rylov) was available for the same geographic area.

Three papers (Clarke 1992; Angel 1993; Piontkovski *et al.* 2003) indicated that biodiversity is higher at lower latitudes and in deeper waters. Moreover, biodiversity increases during ecosystem succession towards a climax stage.

Some terms relating to biodiversity were defined. **Species Richness**: the number of species (taxonomic groups, ecological groups) in a community. This is the simplest measure of biodiversity but does not consider the number of individuals or biomass of a single species in relation to all species. **Species Evenness**: the equitability of the distribution of individuals among species. To understand diversity one needs to integrate both species richness and evenness. **Alpha Diversity**: community related diversity. **Beta Diversity**: diversity over an environmental gradient (among different communities). **Gamma Diversity**: diversity over larger biogeographic regions.

Over sixty different biodiversity indices have been developed in ecology. These have two major forms: dominance indices (e.g. Simpson Index), which show the importance of one species relative to the total number of species; and diversity indices (e.g. Shannon and Weaver Index), which integrate species richness and evenness. In addition there are Evenness Indices (e.g. Pielou 1966) that interpret variations in diversity indices by describing the maximum diversity at a given number of taxa while considering the evenness of their distribution among taxa.

Lutz then gave examples of how different indices were calculated:

$$\text{Simpson Index } D = \frac{\sum_{i=1}^{s} n_i(n_i - 1)}{N(N-1)}$$

where S=number of species, N=total number of organisms, and n=number of organisms of a species. This index ranges from 1 (one species contributes 100%) to 0. It decreases with the increasing importance of more species. Therefore, 1-D ≈ Diversity.

The Shannon and Weaver Index $H_s = \sum_{i=1}^{s} \left(\frac{n_i}{N}\right) \log\left(\frac{n_i}{N}\right)$

Note that $\log_{10}$, $\log_2$, and $\log_e$ are all in use. H_s expresses the uncertainty involved in predicting whether an individual taken at random belongs to a specific species (thus the prediction becomes less certain as H increases. The index increases with increasing species numbers and increasing similarity in relative abundance or biomass concentration.

The problem with interpreting differences in diversity indices is that two variables (species richness and evenness) are changing. One solution is to calculate evenness by using the difference between the actual biodiversity and hypothetical biodiversity. Some examples of indices that utilize this approach were provided. The J′ index (Pielou 1966) appeared to be the most stable and one best suited for general use.

$$J' = \frac{H_s}{\log_2 S}$$

This index describes the maximum diversity at a given number of taxa considering the evenness of the their distribution among taxa. If J′=1, it means that all taxa are evenly present in terms of numbers (or biomass or productivity). Lutz then provided examples of diversity, richness, evenness and dominance within the upper 250 m in the Benguela Frontal region off Angola.

As a practical matter, it was recommended that in publications one notes which taxonomic level was used, what importance value was used, and which logarithm was used in the Shannon and Weaver index. Errors in counting and identification can bias diversity calculations due to the problem of counting rare species.

Turning to the Zooplankton Methodology Manual, Chapter 4.5 deals with Analysis of Community Structure. It addresses questions related to diversity. How many species occur in a study area of a given size? Which device samples diversity more efficiently? How similar are two communities when comparing their dominance structure? How are associations described? The analysis of spatial and temporal formulations. The use of ECOPATH to examine processes within communities.

Biogeography is related to biodiversity. There are a number of multivariate classification techniques that include PRIMER, which uses Bray-Curtis similarity. An example of this technique was demonstrated using data from the Benguela Frontal Region. Lutz concluded his presentation by highlighting the forthcoming World Conference on Marine Biodiversity to be held in Aberdeen, Scotland, on 26–30 September 2011.

References

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8 ToR G: Review the progress towards the workshop: Cross calibration of biochemical indices of growth and validation against somatic growth rates

Presenter: Lidia Yebra; Rapporteur: Tone Falkenhaug

Lidia Yebra presented the progress of the planned workshop. State of the art of enzymatic activity methods is presented in the report WG ICES CM 2004/C:07). The aim of the workshop is to achieve: cross calibration of biochemical indices of growth and validation against somatic growth rates. The intended outcome of the workshop is a peer-reviewed paper with recommendation on methods correlated to somatic growth.

Workshop Activities: a) practical work (growth experiments) 10 days. b) Lectures and discussions (open to students). The plan is to use cultures of copepods at the laboratory of the host. Analyses will be made by the participants at their own labs after the workshop.

Workshop Site: DTU-Aqua were chosen as a host for the workshop (Host: Sigrun Jonasdottir?)

Funding: Applications have been submitted to the EUR-Oceans. Although the this agency encouraged the group to apply, the proposal was not funded. Lidia concluded that it might be easier to get funding at national levels. She asked the group to give suggestions of workshop sites and of possible funding opportunities.

Linda Holste offered to investigate possibilities for having a workshop in Hamburg (Janna Peters lab). Roger Harris suggested to check possibilities at Umeå, Sweden (Ulf Båmstedt) or Kiel (Uli Sommer). The EU may also have visiting grants. Peter Wiebe suggested to explore US-European country agreements as a possible funding opportunity.

9 ToR H: Review the progress of the SGIMT

No members of the SGIMT were present at the meeting and an update on this group was not available.

10 Progress Reports: BCO-DMO Data Management System Update

Presenter: Peter Wiebe

In 2006, the former- U.S. JGOFS and U.S. GLOBEC data management offices were united to form the Biological and Chemical Oceanography Data Management Office (BCO-DMO) (http://www.bco-dmo.org) with an expanded mandate to serve principal investigators funded by the NSF Biological and Chemical Oceanography Sections. The BCO-DMO manages a repository where marine biogeochemical and ecological data and information developed in the course of scientific research can easily be disseminated, protected, and stored on short and intermediate time-frames. The Data Management Office also strives to provide research scientists and others with the tools and systems necessary to work with marine biogeochemical and ecological data from heterogeneous sources with increased efficacy. There are currently 16 programs with 137 projects whose data are being served by BCO-DMO and the office manages data contributed from single investigator projects as well.

The BCO-DMO data management system is composed of three major components: the metadata database, the JGOFS/GLOBEC data management system, and the web

interface supporting simple text-based and geospatial user interfaces that provide access to the information and data available from the BCO-DMO repository. The existence of sufficient metadata enables the discovery and accurate reuse of data beyond just the initial investigators who collect, analyze, process, and contribute the data. A MySQL-based relational database is used to store the metadata and other attributes deemed necessary to support discovery of and access to the stored data.

Web access to the data and metadata is provided in two modes: text-based and map-based. Text-based access uses the information contained in the metadata database to format displays of the available datasets, organized by originating program, project, investigator name, instrumentation, parameter name, cruise, etc. As is common now, all web pages are generated from the most up-to-date information, on demand and directly from the database. Map-based access uses the MapServer software, originally developed at the University of Minnesota, to provide geospatial access to the available datasets. In addition to being able to identify sampling locations on a map, several different data displays have been developed. These include X-Y plots, abundance plots, time-series plots, and 3D perspective ribbon plots, so that investigators can visualize data of potential interest and assess 'fitness for purpose' before deciding to download the data. Two popular exchange standards developed by the Open Geospatial Consortium, Web Mapping Service (WMS) and Web Feature Service (WFS) are supported, as well as the Keyhole Markup Language (KML) used by Google Earth and adopted as an OGC standard in 2008. The data are downloadable via the text interface in ASCII, Ocean Data View, Matlab, or NetCDF, and via the MapServer interface using Google Earth (KML) or using WFS and WMS.

11 Progress Reports: GreenSeas Initiative

Presenter: Mark Benfield; Rapporteur: Maiju Lehtiniemi

Mark Benfield presented the GreenSeas project initiative to contact WGZE for collaboration. The project has approached Mark Benfield by an email through Manuel Barange to ask if GreenSeas could help WGZE work.

GreenSeas (**Development of global plankton data base and model system for eco-climate early warning**) is a 3-year EU FP7 project. It is led by Dr. Johnny A. Johannesen from the Nansen Environmental and Remote Sensing Center (NERSC). There are 8 other Institutes involved, but none of the WGZE group members is taking part in the project.

The main goal of the project is to 'Advance the quantitative knowledge of how planktonic marine ecosystems, including phytoplankton, bacterioplankton and zooplankton, will respond to environmental and climate change.'

GreenSeas aims to reveal the current state of the marine planktonic ecosystem and do the future assessment of climate change by collating historical plankton and associated environmental data sets on a global scale and analyzing them for changes in biogeography and biodiversity. Historical data sets which cover the latitudinal gradient of planktonic data in the Atlantic from the Arctic to the Antarctic will be collated, quality controlled, merged and harmonized to make them comparable.

WGZE was surprised that none in the group was contacted when developing the GreenSeas proposal although group's expertise would have fitted very well to the suggested research plan. Todd O'Brien mentioned that he has not been contacted in terms of data use from the COPEPOD database although GreenSeas will need the data in order to accomplish their goals. In the proposal COPEPOD is mentioned once

among other plankton databases: 'There are several notable plankton databases in the world, falling broadly into three categories: the long term surveys (e.g. the Continuous Plankton Recorder survey (CPR) http://www.sahfos.ac.uk/research.aspx, AMT http://www.pml-amt.org.uk); long-term time-series (e.g. BATS *bats.bios.edu*, HOTS http://hahana.soest.hawaii.edu/hot/hot_jgofs.html,

L4 http://*www.westernchannelobservatory.org.uk*); and global and regional scale datasets (e.g. the world plankton database, COPEPOD

http://www.st.nmfs.noaa.gov/plankton/, ICES).'

GreenSeas will be developing a database with data from provinces and biogeographic regions stretching from the Arctic to the Southern Ocean, containing information on different size-classes of plankton in all the major oceanic ecosystem types. WGZE expressed interest to hear more about the data especially from the Arctic and the Southern Ocean, which is going to be used in the GreenSeas.

Plankton Survey Stakeholder Group (PSSG) will be created during the project to enhance cooperative links between GreenSeas and other surveys. This group will consist of 8–10 external experts representing the wider plankton survey community. This group will provide advice and guidance on the project orientation, with a view to developing a roadmap for the future development of sustainable integrated plankton monitoring and modelling on a global scale. They will participate in the preparation of the final recommendations at the end of the project. WGZE discussed this and decided that the group would like to have a representative in the PSSG.

Mark Benfield replied to the request sent from the GreenSeas for cooperation and wrote the following email to Manuel Barange:

"We follow with interest, the activities of the GreenSeas programme. This is an ambitious initiative that complements the activities of our Working Group. Through cooperation with COPEPOD (www.wgze.net<http://www.wgze.net>), the WGZE serves the most comprehensive zooplankton time-series database in conjunction with environmental data and climate indices. In developing this state-of-the-art system, we have had to address many of the issues raised by GreenSeas with regard to comparing different plankton datasets.

As a great deal of time and effort has been devoted to developing the software tools to provide ICES time-series data to stakeholders, we encourage GreenSeas to avoid duplication of efforts. To this end, they may wish to share their data, particularly the digitized Russian data from the Arctic with our WG so that it can be served via COPEPOD. They may also wish to utilize the ICES Zooplankton Status Report as a resource for guiding their efforts.

When the PSSG is established, we would welcome an opportunity to have representation on that group and look forward to using this venue to share experiences and advances. Next year we would encourage GreenSeas to send a delegate to our annual meeting where we will have an opportunity to discuss linkages and cooperation in more depth. Please keep us informed on the activities and progress of GreenSeas."

12 Progress Reports: New *Mnemiopsis* Program

Presenter: Karl van Ginderdeuren

MEMO" is the acronym for the project title "*Mnemiopsis* Ecology and Modeling: Observation of an invasive comb jelly in the North Sea". The project is implemented through the partnership between five scientific research institutes – ILVO, IFREMER,

ULCO-LOG, CEFAS and Deltares – and led by ILVO. The subject of the research is the comb jelly *M. leidyi* that was observed in the North Sea in 2006. This research project started on 1 January 2011 and is funded by the Interreg IVa MEMO-2 Seas Programme. In total, €3.5 million is allocated over three years and 20 scientists are involved.

The American comb jelly comes from the Atlantic Ocean near the North American coast where it has natural enemies. Presumably it is by ballast water of ships transferred to our region. The ctenophore measures up to 12cm, although in the North Sea and the English Channel they have been observed to be around 1 to 4 cm. It is a voracious animal that feeds on all kinds of fish larvae, fish eggs and plankton. *Mnemiopsis leidyi* are capable of self-fertilization, so one copy is sufficient to start the reproductive cycle. The cycle takes about 2 weeks. *Mnemiopsis leidyi* appears to need little energy and has survived two cold North Sea winters so far.

The invasiveness of the comb jelly *M. leidyi* in the Black and Caspian Sea in the 80s and has led to a major change in the marine ecosystem and economic losses due to a decline in fish and shellfish stocks. In 2006 this species was detected in different regions of the two seas area. The spread of *M. leidyi* in this area is a major concern because of the presence of important spawning and nursery areas and migration routes for many commercial fish and shellfish. The presence and distribution of *M. leidyi* in the two seas region, and its interaction with potential prey and predators in relation to possible changes in the environment must be closely monitored to avoid similar disasters like in southern Europe.

MEMO project has a clear and ambitious goal. The project seeks a better understanding of the identification, biology and physiology of the comb jelly, attendance, behaviour and impact monitoring in the North Sea and the development of models to assess the ecological and economic impact of *M. leidyi* in the two seas region.

This will be achieved through three activities: (1) Development of standard procedures for identification, monitoring and modelling of potential habitat and population dynamics of M. leidyi; (2) Studies of the physiology, eating behaviour and potential predators of the species through experiments and mathematical models; and (3) Evaluation of the potential environmental and socio-economic costs of the impact of the species by an ecosystem-based approach.

The ultimate goal is to inform, with the support of the European Union, stakeholders and the general public about the potential risk of *M. leidyi* on the marine ecosystem and professional activities in the two seas region and to identify possible measures to counter this threat.

13 Progress Reports: Update on the Impact of the Deepwater Horizon Oil Spill on Zooplankton

Presenter: Mark Benfield; Rapporteur: Tone Falkenhaug

Mark presented ADCP data from the spill site that suggested that zooplankton scattering had decreased following the spill compared with a reference site outside of the impact zone. Changes in mean scattering strength also indicated increased variability in the vertical migration during the oil spill.

During the discussion, Roger Harris asked if sediment traps were deployed in the area: No sediment traps were deployed and no oil spill was observed on the seafloor. Roger also asked why did they use dispersants? Mark: Dispersants were used in order to reduce the vapour pressure at the surface and to keep the oil from the coast.

However, the dispersions resulted in more oil in the water column. Preliminary results indicate increased microbial activity in the water column. Klas Møller: Would it be useful to exchange data and experiences from the Exxon Valdes oil spill? Mark: The EV oil spill was very different from the Deep Water Horizon. Different type of oil and environment makes comparisons difficult. Mark: At present there are too few quantitative data in order to demonstrate direct, short-term effects of the oil spill.

14 Progress Reports: Modifying the MOCNESS with a Strobelight

Presenter: Peter Wiebe; Rapporteur: Tone Falkenhaug

Adult krill are well known for their ability to avoid capture by standard oceanographic plankton nets. Previous studies have shown enhanced catching rates when the nets were equipped with flashing lights. During a study of krill/herring interactions in Franklin/Georges Basins (Gulf of Maine) in the fall of 2010, MOCNESS tows were made to provide ground truth for acoustic surveying of the krill and fish. The 1-m^2 MOCNESS was equipped with a newly designed LED based strobe light and a study was done to evaluate its efficacy in increasing krill capture rate. Two tows were taken, one during the night targeted a layer between 60 and 75 m and the other during the day targeted a layer between 160 and 190 m. Four of the nets fished with the strobe light operating at one-second intervals and four fished with the strobe light off. The sequence of on/off was random. Only the night tow has been worked up to date. On this tow, total displacement volume was significantly increased by a factor of 2.2 when the strobe light was on due largely to the enhanced catch of adult krill. The abundance of adult krill (mostly *Meganytiphanes norvegica*) was increased by 4.5. While the krill results from the second tow remain to be determined, an image (Figure 1) taken after the tow of the catches by each net indicate a significant enhancement to the catch occurred during the daytime as well. These preliminary current results suggest that the new MOCNESS strobe light system significantly reduces the effects of krill net avoidance and reaffirms the results of earlier studies. Thus studies of krill distribution that use standard nets without a strobe light system risk seriously under estimating the adult krill standing stock in the study region. This work is being carried out in collaboration with Gareth L. Lawson, Andone C. Lavery, Nancy J. Copley, Erich Horgan, and Albert Bradley all at the Woods Hole Oceanographic Institution.

Piotr asked whether it was possible that the euphausiids were attracted by the light, leading to an overestimation of abundance? Peter felt that the strobelight was blinding the krill, not attracting them. The krill will not have time to aggregate in front of the moving MOCNESS.

Klas Møller asked if Peter had tried the strobelight on optical systems such as the VPR? Peter responded that he had not, however, when a vertical VPR cast was made (without a strobelight), no euphausiids were observed.

Mark told about another experience when deck-lights on ships caused a behavioural response by *Euphausia pacifica* that resulted in the scattering layer to disperse, presumably due to a change in the angle of orientation of the krill thereby reducing the backscattering.

Tone Falkenhaug asked if similar mechanisms might also be present in mesopelagic fishes. Peter indicated that he thought that fishes probably do not respond to bioluminescence in similar way as the euphausiids.

Maiju Lehtiniemi asked if this could also work for mysids? Piotr pointed out that in the Baltic, sampling of mysids is very inefficient, so this may be an interesting approach in order to increase the catches. Mark remarked that when using acoustics combined with ROV studies, colleagues working in Lake Ontario found that mysids were observed to acoustically 'disappear' when light was turned on.

15 Progress Reports: Plankton activities at IHF, Hamburg

Linda presented results from experimental studies on egg production in *Acartia tonsa* at different temperatures and salinities. The results show that copepods are able to adapt to rapid changes in temperature. There are plans for studies on hatching success and resting egg dynamics. This includes incubation of resting eggs at different environmental conditions (T, O2, S, POM) sampled in the field. Nauplii will be identified via genetics.

The aim of these experiments are to find triggers for the hatching of resting eggs and to produce a biochemical time-series. Linda encouraged the group to cooperate on experimental studies. Elaine asked whether they have you made any salinity studies on *Oxyrrhis* (a dinoflagellate with a very high salinity tolerance)? Linda: Currently no one is studying this in the lab.

16 Progress Reports: Theme Sessions at the 2011 ASC and Proposals for Theme Sessions for the 2012 ASC

Presenter: Mark Benfield

There are two theme sessions at the 2011 ASC to be held in Gdansk, Poland from 19 to 23 September. Theme session J: "Climate and fisheries related influences on marine ecosystems at regional and basin scales" will be co-chaired by Webjorn Melle and Erica Head. Theme session K: "Integrating micro- and mesozooplankton in marine food web research" will be co-chaired by Jaimie Pierson, Steve Hay, and Sigrun Jonasdottir.

Attention was also drawn to Theme session F: "Applications of optical and image based technologies in the ecosystem approach to fisheries management".

Potential theme sessions for the 2012 ASC included: Application of new genetic techniques to food-web studies (co-chairs: Ann Bucklin, Steve Hay, and Penny Lindeque); and The Deepwater Horizon oil spill: what have we learned to understand future environmental impacts relating to pelagic ecology (co-chairs: Mark Benfield and Cabell Davis).

17 Progress Reports: SCICOM Codes and Selection of Topics for 2012 ToRs

Mark Benfield summarized the SCICOM Science Plan codes that are used to categorize ToRs within a common framework. He presented the coding of our 2011 ToRs using the scheme and discussed the importance of attempting to select ToRs that diversify as much as is possible, the breadth of what we address. Our current ToRs and their SCICOM codes are given below.

Term of Reference	Code 1	Code 2	Code 3
a) Identify current zooplankton sorting centres and laboratories and prepare a review of their services, costs, and taxonomic expertise.	121	113	0
b) Build on the work relating to microzooplankton completed in Riga (2007) and explore the extent to which microzooplankton could be included in the zooplankton time-series produced in the Plankton Status Report.	121	162	0
c) Prepare a report on updating the Zooplankton Methodology Manual including identifying areas of the manual that require updating and activities that lend themselves to multimedia tutorials (e.g. videos) to be served via the web.	0		
d) Review the Zooplankton Status Report and consider further developments and improvements to its contents including new time-series and additional analyses.	121	162	321
e) Review the outcomes of SCOR 137 (Coastal Phytoplankton Time-Series) and SCOR 130 (Automatic Visual Plankton Identification) and summarize findings relevant to zooplankton ecology.	121	245	000
f) Define the meaning of the term 'biodiversity' with respect to zooplankton including its definition, measurement, and relevant indices based upon it.	121	346	162
g) Review the progress towards the workshop: Cross calibration of biochemical indices of growth and validation against somatic growth rates.	000	346	
h) Review the progress of the SGIMT.	121	122	346

18 Identification of Terms of Reference for 2012

The Working Group agreed upon the following Terms of Reference. The corresponding SCICOM Science Plan codes are listed.

Term of Reference	Code 1	Code 2	Code 3
a) Review videos of zooplankton sampling/processing techniques as part of progress in updating the Zooplankton Methodogy Manual.	000		
b) Review allometric relationships relating zooplankton morphology to volume, mass, carbon and identify data needs, utility, and regional applicability of these equations.	144	152	161
c) Update and discuss expanded content for the 2012 Zooplankton Status Report and consider areas where the Phytoplankton and Zooplankton Status Reports could be harmonized.	321	162	141
d) Identify analytical approaches and the potential for publications arising from more advanced analysis of existing time-series data on phytoplankton, zooplankton, hydrography, and climate.	322	162	115
e) Summarize the status of blooms by gelatinous zooplankton in coastal and shelf ecosystems.	112	162	245
f) Summarize regional examples of understudied zooplankton that may be ecologically important but which are not currently monitored.	152	162	121
g) Review the content of the summary of zooplankton sorting centres produced in the past year.	113	121	000
h) Identify relevant zooplankton indicators with utility for assessment of ecosystem quality.	143	162	311
i) Review the progress of the SGIMT.	121	122	346
j) Review the outcomes of theme sessions J and K from the 2011 Annual Science Conference.	000	11X	

19 Election of a New Chairperson and Selection of a Venue for the 2012 Meeting

The current Chairperson's term of office expires at the end of 2011. Nominations were opened for a new Chairperson. Mark Benfield nominated Piotr Margonski and this was seconded by Roger Harris. Piotr accepted the nomination and was elected chair by a unanimous vote.

Our next meeting will be held jointly with the WGPME. Erica Head and Bill Li offered to host the meeting in Halifax, Nova Scotia. Lidia Yebra offered to host the meeting in Malaga, Spain. The consensus of the group was that a meeting in Malaga would be easier for more members to attend given the ease of obtaining affordable flights and that the climate during March in Malaga would be an additional attraction. We contacted the chairs of the WGPME (Bill Li and Xelu Moran) and they supported the Malaga venue. At the annual meeting of the WGPME, they formally voted to hold a meeting with the WGZE in Malaga, Spain, 26–29 March 2012.

Mark Benfield thanked the members and guests for their contributions and the group expressed their gratitude to Piotr Margonski and his colleagues and students at MIR for their outstanding hospitality and logistical support of the meeting. The meeting was adjourned.

Annex 1: List of participants

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Annex 2: Agenda

Tuesday 25 Jan 2011

09:00 – 0930	Meeting Open, Introductions, Logistics, Adopt Agenda (Mark Benfield, Piotr Margonski)
09:30 – 10:30	ToR A: Identify current zooplankton sorting centres and laboratories and prepare a review of their services, costs, and taxonomic expertise (Piotr Margonski and colleagues from Polish Plankton Sorting Center). [RAP: Klas Ove Moeller]
10:30 – 11:00	Coffee Break
11:00 – 11:30	ToR A: Discussion and assignments
11:30 – 12:00	ToR B: Build on the work relating to microzooplankton completed in Riga (2007) and explore the extent to which microzooplankton could be included in the zooplankton time-series produced in the Plankton Status Report
12:00 – 13:30	Lunch
13:30 – 14:00	BCO-DMO Data Management System Update (Peter Wiebe)
14:00 – 15:00	ToR C: Prepare a report on updating the Zooplankton Methodology Manual including identifying areas of the manual that require updating and activities that lend themselves to multimedia tutorials (e.g. videos) to be served via the web (Roger Harris) RAP: Hogni Debes
15:00	Coffee Break
15:30– 16:30	ToR C: Discussion and assignments

Wednesday 26 Jan 2011

09:00 – 10:00	WGPME and WG137 (Phytoplankton Time-series) Progress. *This covers part of ToR E.* (Todd O'Brien) and COPEPODITE: COPEPOD Interactive Time-series Explorer (Todd O'Brien)
10:00 – 10:30	GreenSeas Initiative (Mark Benfield)
10:30 – 11:00	Coffee Break
11:00– 11:30	ToR D: Review the Zooplankton Status Report and consider further developments and improvements to its contents including new time-series and additional analyses (Todd O'Brien)
11:30 – 12:00	New *Mnemiopsis* Program (Karl Van Ginderdeuren)
12:00 – 13:00	Lunch
13:00– 13:30	ToR E: Review the outcomes of SCOR 137 (Coastal Phytoplankton Time-Series) (Todd O'Brien) and SCOR 130 (Automatic Visual Plankton Identification) and summarize findings relevant to zooplankton ecology (Mark Benfield)

13:30 – 14:30	ToR F: Define the meaning of the term 'biodiversity' with respect to zooplankton including its definition, measurement, and relevant indices based upon it (Lutz Postel).
14:30 – 15:00	Revisit ToR B
15:00 – 15:30	Coffee Break
15:30 – 16:00	ToR G: Review the progress towards the workshop: Cross calibration of biochemical indices of growth and validation against somatic growth rates (Lidia Yebra).
16:00 – 16:30	Update on the Impact of the Deepwater Horizon Oil Spill on Zooplankton (Mark Benfield)
16:30 – 17:00	Modifying the MOCNESS with a Strobelight (Peter Wiebe *et al.*)

Thursday 27 Jan 2011

09:00 – 09:30	Theme Sessions at the 2011 ASC and Proposals for Theme Sessions for the 2012 ASC (TBA)
09:30 – 10:30	Discussion: SCICOM Codes and Selection of Topics for 2012 ToRs
10:30 – 12:00	TBA
12:00 - 1900	Visit Old Town of Gdansk

Friday 28 Jan 2011

09:00 – 10:30	Continue discussion of 2012 ToRs
10:30 – 11:00	Coffee Break
11:00 – 12:00	Selection of location for next meeting and nomination of a new Chairperson.
12:00	Close Meeting

Annex 3: WGZE draft terms of reference for the next meeting

The **Working Group on Zooplankton Ecology** (WGZE), chaired by Piotr Margonski, Poland, will meet in Malaga, Spain, 26–29 March 2012 to:

a) Review videos of zooplankton sampling/processing techniques as part of progress in updating the Zooplankton Methodogy Manual;

b) Review allometric relationships relating zooplankton morphology to volume, mass, carbon and identify data needs, utility, and regional applicability of these equations;

c) Update and discuss expanded content for the 2012 Zooplankton Status Report and consider areas where the Phytoplankton and Zooplankton Status Reports could be harmonized;

d) Identify analytical approaches and the potential for publications arising from more advanced analysis of existing time-series data on phytoplankton, zooplankton, hydrography and climate;

e) Summarize the status of blooms by gelatinous zooplankton in coastal and shelf ecosystems;

f) Summarize regional examples of understudied zooplankton that may be ecologically important but which are not currently monitored;

g) Review the content of the summary of zooplankton sorting centres produced in the past year;

h) Identify relevant zooplankton indicators with utility for assessment of ecosystem quality;

i) Review the progress of the SGIMT;

j) Review the outcomes of theme sessions J and K from the 2011 Annual Science Meeting.

WGZE will report by 15 May 2012 (via SSGEF) for the attention of SCICOM and ACOM.

Supporting Information

Priority:	The activities of this group are a basic element of the SSGEF, fundamental to understanding the relation between the physical, chemical environment and living marine resources in an ecosystem context. Reflecting the central role of zooplankton in marine ecology, the group members bring a wide range of experienced expertise and enthusiasm to bear on questions central to ICES concerns. Thus the work of this group must be considered of very high priority and central to ecosystem approaches.
Scientific justification	Action Plan No: 1. Term of Reference a) Review videos of zooplankton sampling/processing techniques as part of progress in updating the Zooplankton Methodogy Manual. SCICOM Science Code: 000 (Capacity Building). Updating the ICES Zooplankton Methodology Manual has been identified as a priority activity by this group. Many techniques mentioned in the manual are most effectively communicated visually. A series of short (3 min) videos will be produced by teams within the group, leading to production of a video series that compliments concepts in the ICES Zooplankton Methodology Manual. This is a first step in updating the latter. Term of Reference b) Review allometric relationships relating zooplankton

morphology to volume, mass, carbon and identify data needs, utility, and regional applicability of these equations.

SCICOM Codes: 144, 152, 161. Allometric relationships are commonly used to quickly convert routinely collected monitoring data into estimates of zooplankton standing stock that are requested for the assessment and management of the marine ecosystem.At present a wide variety of allometric relationships are available for many zooplankton taxa in the literature; however, there are many taxa for which, useful allometric equations are lacking.For those equations that have been obtained with different methodologies, or for the same taxon from different regions, an intercomparison is needed to assess their performance in reproducing a realistic zooplankton biomass.

Term of Reference c) Update and discuss expanded content for the 2012 Zooplankton Status Report and consider areas where the Phytoplankton and Zooplankton Status Reports could be harmonized.

SCICOM Codes: 321, 162, 141. The Zooplankton Status Report continues to evolve as a major published output of the WGZE. New data analyses and techniques for comparative analysis of time-series within the ICES area will be incorporated in this next report, with a focus on expanding the regional overviews. In cooperation with WGPME, the zooplankton report will include microzooplankton and chlorophyll. The intent of this cooperation is to provide two detailed yet complimentary reports which will cover the planktonic ecosystems for the ICES Areas.

Term of Reference d) Identify and evaluate analytical approaches and the potential for publications arising from more advanced analysis of existing time-series data on phytoplankton, zooplankton, hydrography, and climate as summarized in existing ICES status report time-series data.

SCICOM Codes: 322, 162, 115. The Zooplankton Status Report now covers the zooplankton time-series of 40 sites located in Western North Atlantic, Nordic, Barents, Baltic, North Sea, Northwestern Iberian, and Mediterranean Seas as well as accompanying data series on sea surface temperature, chlorophyll concentration and surface salinity data (Baltic Sea only). Parallel reports on hydrography and phytoplankton also exist. Synthesis of these data provides an opportunity to create a more comprehensive examination of long-term plankton community changes. An example of similar analysis carried out for seven different subregions of the Baltic Sea (ICES CRR 302) gives an example how the understanding of the ecosystem change due to e.g. climate and anthropogenic impact may benefit from the multiple time-series analyses.

Term of Reference e) Summarize the status of blooms by gelatinous zooplankton in coastal and shelf ecosystems.

SCICOM Codes: 112, 162, 245. Recent concerns that jellyfish populations are increasing have stimulated speculation about possible causes including climate change, eutrophication, over fishing and invasions. Their fragile nature often means that gelatinous zooplankton are poorly represented in regular monitoring programs, and many time-series are still too short to interpret causality. This ToR will give a summary of the status of the blooms and ongoing monitoring and research activities on gelatinous zooplankton.

Term of Reference f) Summarize regional examples of understudied zooplankton that may be ecologically important, but which are not currently monitored.

SCICOM Codes: 152, 162, 121. There are groups of zooplankton (e.g. mysid shrimps, euphausiids and meroplankton) which are not presently monitored because of difficulties in finding proper sampling techniques and adequate taxonomic expertise. The absence of such taxa will bias ecosystem models due to missing links in the trophic webs in terms of carbon and energy flow. These unmonitored groups of zooplankton will be summarized and sampling options discussed.

Term of Reference g) Review the content of the summary of zooplankton sorting centres produced in the past year.

SCICOM Codes: 113, 121, 000. Taxonomists are a threatened species and

	taxonomic skills are vanishing quickly. It is of high importance to know which taxonomic expertise is present, and where it is situated. Therefore it is adequate to list taxonomic centers and even single experts to present their competence, experience and processing abilities on particular groups of zooplankton. In the case of many laboratories there are numerous samples, which have not been analyzed so far. Therefore we should also identify and review the centers capable of helping to solve this problem. In order to have an overview of the taxonomic landscape it might also be taken down not only which expertise is present, but also which knowledge has gone and in which fields it is most urgent to train new people. Term of Reference h)Identify relevant zooplankton indicators with utility for assessment of ecosystem quality. SCICOM Codes: 143, 162, 311. Marine management of the pelagic ecosystem has traditionally used phytoplankton and fish as indicators for ecosystem quality. However, little attention has been paid to zooplankton. Information on zooplankton are compiled by the WGZE, e.g. in the Zooplankton Status Report. This information could be relevant to improve the assessment of ecosystem quality with regard to biodiversity, invasive species, and food web relations. Term of Reference i) Review the progress of the SGIMT. This topic relates to SCICOM Science Codes: 121, 122, and 346. This study group is addressing issues of taxonomy that are directly relevant to zooplankton ecology as well as the broader ICES community. Close linkages between the WGZE and the SGIMT will ensure that the latter is successful and will keep members of the former informed about new developments in this area. Term of Reference j) Review the outcomes of theme sessions J and K from the 2011 ASC. SCICOM Codes: 000, 11X, . The outcomes of Theme Sessions(J): Climate and fisheries related influences on marine ecosystems at regional and basin scales; and (K) Integrating micro- and meso-zooplankton in marine food web research, will be important to plankton and fisheries researchers. Moreover, microzooplankton are important to both the WGZE and WGPME. Information presented at these session will be summarized.
Resource requirements:	Resource required to undertake the activities of this group is negligible. However, ICES must be committed to provide some sponsorship and support for workshops, publication costs for the Plankton Status Report
Participants:	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities:	None.
Financial:	No financial implications.
Linkages to advisory committees:	The Group reports to the SSGEF, SCICOM and ACOM. Mainly WGZE provides scientific information on plankton and ecosystems to the SSICC and welcomes input from other committees, working/ study groups etc.
Linkages to other committees or groups:	Any and all working and study groups interested in marine ecosystem monitoring and assessments, modelling and/or plankton studies, including fish and shellfish life histories and recruitment studies. Strong working links have been developed between WGZE and Mediterranean colleagues (CIESM). The newly-formed WGPME will likely work closely with WGZE on issues of microzooplankton ecology and trophic coupling between phytoplankton and zooplankton.
Linkages to other organizations:	Links with the WGPME and WGHABD are intended and some contact is maintained. The WGZE input to REGNS is an ongoing effort. The Plankton Status Report is of interest and practical use to a range of interested groups within ICES, PICES, CIESM, GOOS and GLOBEC with other national and international research groups and agencies. Increasingly marine research, marine management and even marine institutes are re-aligning to take an ecosystem view. These linked and collaborative approaches between many working and study groups must be encouraged. IGBP, SCOR, ESF, COML/

	CMarZ, and others have research activities meetings etc., of interest and relevant to the activities of the WGZE. Contacts are maintained through networking and collaborative activities.

Annex 4: Recommendations

RECOMMENDATION	FOR FOLLOW UP BY
1. ToRs for the WGZE 2012 meeting	WGZE
2. Publication of the Zooplankton Status Report as a CRR	WGZE, Publications Committee
3. Review contents of Zooplankton Methodology Manual to identify areas in need of revision or updating	WGZE
4. Prepare Theme Session proposal for 2012 ASC	WGZE, SSGEF