

# ICES WGZE REPORT 2018

ECOSYSTEM PROCESSES AND DYNAMICS STEERING GROUP

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## Interim Report of the Working Group on Zooplankton Ecology (WGZE)

19–22 March 2018

Helsinki, Finland



**ICES**  
**CIEM**

International Council for  
the Exploration of the Sea

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## Executive summary

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The ICES Working Group on Zooplankton Ecology (WGZE) met at the Finnish Environment Institute (SYKE), Helsinki, Finland, 19–22 March 2018. The meeting was chaired by Sophie Pitois, UK, and Lidia Yebra, Spain, and was attended by 31 scientists representing 15 countries. The objective of the meeting was to discuss and address the 11 terms of reference (ToRs) and to exchange information on recent activities in zooplankton ecology.

Six of the ToRs were focused on the expansion of information and data collected by the group and periodically presented in the Zooplankton Status Report: b) compile data and provide expert knowledge and guidance in the definition of key traits of zooplankton species; d) macrozooplankton in the mesopelagic zone; e) analyze changes in the geographic distributions, seasonal patterns, and interannual trends of Arctic and North Atlantic macro- and meso- zooplankton species; f) gelatinous plankton time-series collection, and recommendations regarding monitoring; g) determine the status of microzooplankton time-series data collection; and i) expand and update the WGZE zooplankton monitoring and time-series compilation.

Within ToR a) a peer-review article on calculations of zooplankton productivity and metabolic activity with special regard to the euphotic zone of the North Atlantic and adjacent seas is being prepared for submission to ICES Journal of Marine Science. Also, a review article is being prepared on image analysis systems within the ToR h) that will summarize a rapid development of those tools supporting the automatic and semi-automatic plankton identification.

Future areas of coordinated and collaborative activities between WGZE, WGIMT, and WGPME were discussed under the ToR j). The groups supported the idea of having a joint meeting in 2019.

Work on ToR k) was put on hold last year but after proposing a new co-editor, the revision and updating of ICES Zooplankton Identification Leaflets will soon be resumed.

Continuing with the WGZE contribution to the Ecosystem Overviews, the group reviewed the text and figures corresponding to the Baltic Sea for their submission to SCICOM and WGIAB.

Next year WGZE will meet jointly with WGPME. The meeting will be hosted by Instituto de Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria (ULPGC), Las Palmas de Gran Canaria, Spain, 11–14 March 2019.

## 1 Administrative details

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<p><b>Working Group name</b> Working Group on Zooplankton Ecology (WGZE)</p> <p><b>Year of Appointment within current cycle</b> 2018</p> <p><b>Reporting year within current cycle (1, 2 or 3)</b> 1</p> <p><b>Chair(s)</b> Lidia Yebra, Spain Sophie Pitois, UK</p> <p><b>Meeting dates</b> 19–22 March 2018</p> <p><b>Meeting venue</b> Helsinki, Finland</p>
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## 2 Terms of Reference

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- a) Review the use of zooplankton production methodologies in collaboration with PICES BIO WG37;
- b) Compile data and provide expert knowledge and guidance in the definition of key traits of zooplankton species in the ICES area;
- c) Recovery of "Dark Data" (datasets that are not available publicly) collected on or before WGZE time-series were started around 1990;
- d) Macrozooplankton in mesopelagic zone;
- e) Analyze changes in the geographic distributions, seasonal patterns, and interannual trends of Arctic and North Atlantic macro- and meso- zooplankton species;
- f) Gelatinous plankton – time-series collection, and recommendations regarding monitoring;
- g) Determine the status of microzooplankton time-series data collection within the ICES area;
- h) Review the applicability of continuous and realtime zooplankton techniques in long-term monitoring;
- i) Expand and update the WGZE zooplankton monitoring and time-series compilation

- j) Design and carry out coordinated and collaborative activities with WGIMT and WGPME (including the molecular/taxonomic tasks);
- k) Develop, revise and update of zooplankton species identification keys initially focusing on the most abundant taxa at the ICES time-series sites and ensuring their availability via the web, including especially ICES Zooplankton identification leaflets.

### 3 Summary of Work plan

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Year 1 We dealt with all of the ToRs in Year 1. At the moment, all the ToRs are planned as three-years activities covering the entire extension period. Certainly, a various workload intensity in specific ToRs in each year is expected.

### 4 List of Outcomes and Achievements of the WG in this delivery period

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- Discussion on the planning of the 7th ZPS started between WGZE and PICES Deputy Executive Secretary (Hal Batchelder). WGZE members from USA and Canada will explore possibilities to organise the next ZPS in North America.
- Three topics for 2019 ASC theme sessions were outlined, with potential links with WGIMT, WGIAB, WGPME, WGOH and WGSPEC.
- The group provided an update of the zooplankton section for the Baltic Sea for the ICES Ecosystem Overviews.
- Endorsement of the “First Advanced Zooplankton Course - Morphological and Molecular Taxonomy of Marine Copepods” scheduled for 22nd October – 2nd November 2018 at Stazione Zoologica Anton Dohrn, Naples, Italy, and organised by Maria Grazia Mazzocchi and Iole Di Capua.
- Progress has been made regarding preparations of several scientific publications (led by Lutz Postel and Klas Ove Moller).

### 5 Progress report on ToRs and workplan

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#### Progress on ToR a)

WGZE coordination with PICES BIO WG37 is focused on reviewing the use of zooplankton production methodologies. Collaborative papers include a review on biochemical methods in *Adv. Mar. Biol.* (Yebra *et al.*, 2017) and one on traditional methods to estimate zooplankton growth (close to submission). Another publication in preparation is well advanced to be submitted to ICES JMS on calibration of zooplankton productivity and metabolic rates (previously WGZE ToR j); 2015–2017). A further paper on the application of Ikeda – Motoda models to time-series will be presented at the upcoming PICES meeting in Japan. Other activities for 2018 include the organisation of a theme session at ASLO/AGU Ocean Sciences Meeting (2018 Portland, Oregon), and a workshop on conceptual and practical aspects of various methodologies that will allow exchange of information, comparison and calibration (Japan). Progress is being made on building a database for biomass/production data, including equations, rates and measures, in par-

ticular allometric, biometric, and environmental variables. In the near future, the database will store and serve biomass, Nitrogen and Phosphorus content, and rates. The initial 2016–2017 “biomass and production data” compilation effort was focused on gathering and putting these data into a common format and database. During the 2017–2018 period, this focus was expanded to test real-use application of the data compilation to WGZE time-series species abundances. Work during next year will continue to add new biomass and production data as well as identifying species in the WGZE time-series collection that currently do not have size or weight data in the data compilation. ToR a) is also working cooperatively with the ToR b) zooplankton traits effort, as it is common for length and weight data to be included in the traits literature and data.

#### **Progress on ToR b)**

The following issues were discussed to be fulfilled within the 3 year term: 1) to compile a database of known species-level zooplankton traits for the North Atlantic and adjacent seas; 2) to compile a “wish list” of key zooplankton species within the ICES area that are still missing some or all trait data, and 3) to write a peer-reviewed publication on the methods and data of this compiled database. The following data gaps were identified to be missing in available databases: taxa other than copepods, e.g. decapods, hydrozoans, mysids, euphausiids; and some traits, such as growth and clearance rates, reproduction frequency, vertical migration, motility or size at maturation are currently missing. Furthermore, in the existing databases the areas of origin are not explicitly mentioned, although available via references given in the datasets, therefore the data/taxa coverage within the ICES area needs a detailed analysis. The issue about “dark data” was discussed and it was agreed that recovering these data might have a good impact on the database. Members of the WGZE were encouraged to send their “dark data” to Todd O’Brien.

#### **Progress on ToR c)**

Zooplankton dark data are data sets collected in the past that are not available in public open data repositories, but hidden on log books or computer hard drives and discs in investigators labs, etc. Examples of application of successful “dark data” recovery were presented. The recommended metadata for zooplankton samples, created by the WGZE in 2003, is now on the SharePoint for easy access. A metadata spreadsheet provided by ICES, to provide zooplankton data to the ICES data repository, has also been uploaded on the SharePoint. A number of WGZE members have dark data sets that could be a starting point for this ToRs three year effort.

#### **Progress on ToR d)**

This first year, a compilation of studies addressing key issues such as taxonomy, biomass, trophic ecology, reproductive biology, and carbon flux in relation to macrozooplankton in the mesopelagic zone was started; with the aim to produce a summary publication.

#### **Progress on ToR e)**

This ToRs has both “macrozooplankton” and “mesozooplankton” elements. The first year of this three-year ToR were (1) to identify and compile available species-level data from WGZE time-series programs, and (2) to apply initial, exploratory analysis on the

data to identify the target species groups and analytical methods for the study. Next year, the changes in the geographic distributions, seasonal patterns, and interannual trends of Arctic and North Atlantic macro- and mesozooplankton species will be investigated. Time-series on macroplankton (euphausiids, amphipods, chaetognaths etc.) from the ICES regions will be mapped and explored in this context.

#### **Progress on ToR f)**

After discussion, it was agreed that the “gelatinous zooplankton” group should include Cnidaria and Ctenophora but also chaetognaths. The members of the group were requested to provide an inventory of existing gelatinous plankton time-series in order to compile metadata on the available datasets, as well as to propose and revise methodologies used for sampling these organisms. The importance of citizen science in studying gelatinous organisms was emphasized, as well as the reporting of gelatinous plankton from the bycatch of fisheries surveys. The overall conclusion was that we should establish one, common and specifically dedicated method of collecting gelatinous zooplankton as well as involve citizen scientists in data collection.

#### **Progress on ToR g)**

The role of microzooplankton in the marine food web was previously reviewed by the WGZE as a ToR in 2007 and their findings were discussed in the annual meeting in Riga, Latvia. The group at that time decided that WGZE should include both micro- and mesozooplankton experts and that microzooplankton time-series and monitoring should be encouraged in the ICES area. The purpose of this current ToR, therefore, is to assess progress made in this area over the last ten years, and identify collaboration, gaps or overlap with other expert groups. Prior to the meeting, a survey on microzooplankton time-series was circulated to all WGZE and WGME members; responses received were collated and presented but it is anticipated that more responses will be received over the coming months. A sampling gear and mesh size comparison was presented, a key finding was the effect of mesh size (e.g. 63µm vs. 200µm) and gear type (e.g. net vs. Niskin bottle) that can lead to differences in sampled micrometazoa by a factor of > 1500. The overall recommendation of net mesh size for microzooplankton was 20µm, although for delicate protozoa water bottles are the preferred method of sample collection. A common agreement was also made in terms of the relevance and inclusion of copepod eggs in monitoring programs and analyses.

#### **Progress on ToR h)**

An overview on the present real-time zooplankton sampling techniques/sites was presented with suggestions for the focus of recommendations for the implementation of these techniques into long-term time-series. A number of time-series sites presently using real-time methods were identified and highlighted. Most sites use imaging systems.

#### **Progress on ToR i)**

Unfortunately, the joint WGZE/WGPME ICES Plankton Status Report (PSR) was delayed for a full year due to Todd O'Brien and WGZE's heavy participation in a global time-series status report created by the IOC-UNESCO International Group for Marine Ecological Time-series (IGMETS). Now that the IGMETS report is completed, the



WGZE/WGPME authors will focus on the ICES PSR. However during the delay, Todd developed a new WGZE/WGPME analysis and graphical presentation for the “PSR-2018” report’s expansion into a month- and season- based analysis. The “PSR 2018” will be divided into different ocean regions, as done in the past, but minor changes to the regions were made to better match the regions used in the ICES IROC hydrographic report. As in the previous reports, the CPR will have its own “trans-Atlantic” summary chapter.

#### **Progress on ToR j)**

An overview of WGIMT activities over the past year was presented and collaborative links with WGZE and potentially WGPME were highlighted and discussed. To support the collaborative goals and needs of WGZE, WGIMT, and COPEPOD (The Global Plankton Database), Todd O’Brien has created a taxonomic-based information database called “COPEPEDIA” (<http://copepedia.org>). The continuing development and implementation of the WGIMT web platform for promotion and exchange of relevant scientific information was presented and discussed. WGPME shares the focus on analysis of biodiversity using metabarcoding approaches, and this formed the subject of a joint theme session (WGIMT, WGPME, WGZE) for the ICES 2017 ASC. Further theme sessions organised include the ASLO/AGU Ocean Sciences Meeting (2018 Portland, Oregon) and the ICES ASC to be held in Hamburg, September 2018. WGIMT is jointly involved in WGZE ToR g), to determine the status of microzooplankton time-series data collection within the ICES area. This ToR is also of interest to WGPME and a joint WGZE/ WGPME meeting was proposed for 2019.

#### **Progress on ToR k)**

A list of leaflets to be revised has been generated, potential authors and reviewers (where already available) were identified and official invitations have been prepared. Three experts for gelatinous plankton have been contacted, one expert from Japan has agreed to contribute but did not provide any manuscript. MariaGrazia Mazzochi (member of WGZE) offered to provide the manuscript for the new Leaflets for *Oithona* and *Temora*. However, progress has been slow due to the following issues: 1) it is difficult to convince experts to commit to this project because their contribution is voluntary, 2) many experts are retired, 3) experts for specific zooplankton groups may be identified for the work but their expertise may be limited to a specific region of the world, and 4) Claudia Castellani, one of the original leaders for this ToR, is no longer available to help with it. The WGZE agreed to proceed with this ToR and Lidia Yebra will support Antonina dos Santos. Also, attempts will be made to recruit an expert from WGIMT/ WGPME to support the progression of this ToR.

In addition to the above ToRs, a short discussion was carried out on planning the future Zooplankton Production Symposium (ZPS). This symposium is a common initiative of ICES and PICES and if both organizations would like to keep 5-years intervals the next one should be organized in 2021. It is crucial to decide about the next venue soon as, in the case of symposium in Bergen, preparations took more than two years. Lidia Yebra contacted Hal Batchelder (PICES Deputy Executive Secretary) asking if there were any commitments to host the 7<sup>th</sup> ZPS. Hal Batchelder responded that an initial idea was to focus on North America as ZPS was never hosted there. During the last symposium in Bergen some discussions were carried out with participants from USA and Canada but

unfortunately no official invitation has been received so far. Certainly if symposium is going to be organized in USA then NOAA has to be involved and committed. It was decided that after the WGZE meeting participants representing USA and Canada will contact authorities in their home countries to explore possibilities to organize the 7<sup>th</sup> ZPS in 2021. The possible venue could be e.g. Quebec or Halifax in Canada or Boston in USA.

Discussion on 2019 theme sessions: Both WGZE and WGIMT are very successful in suggesting theme sessions in recent years. One of the key elements of the accepted proposal is to make it attractive for representatives of other expert groups.

Three preliminary ideas were discussed:

- 1) “What can plankton time-series tell us about climate change?” with Todd O’Brien as a WGZE co-convenor. Agata Weydmann volunteered to help with preparation of the themes session synopsis. This idea should be potentially attractive also for WGPME and it has to be discussed at their meeting next week.
- 2) “Bridging the ecosystem structure and ecosystem function” (with focus on traits) to be co-convened by Jasmin Renz (WGZE) and Saskia Otto (WGIAB). Contacting representatives of expert groups working on small pelagic fish as well as modellers may extend the contribution from wider ICES community.
- 3) “New approaches to the understanding of energy transfer through the food-webs” with Lidia Yebra and Janna Peters as co-convenors representing WGZE and WGIMT.

## **6 Revisions to the work plan and justification**

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ToR k) was delayed resulting from the issues mentioned above. This has been communicated to SCICOM and a new deadline has been proposed for the delivery of the first leaflet.

WGZE discussed the possibility of adding a new ToR next year: Planning of the 7th Zooplankton Production Symposium.

## **7 Next meetings**

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WGZE will meet jointly with WGPME in 2019. The meeting will be hosted by Santiago Hernández-León, Instituto de Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria (ULPGC), Gran Canaria, Spain, 11–14 March 2019.

## Annex 1: List of participants

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## Annex 2: Recommendations

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RECOMMENDATION	ADDRESSED TO
1. Propose Theme Sessions for the 2019 ASC	WGZE
2. Nominate Antonina dos Santos and Lidia Yebra as editors of the Zooplankton ID series	SCICOM, ICES Secretariat
3. Develop a coordinated, collaborative activity plan together with: WGZE, WGIMT & WGPME	WGZE, WGIMT & WGPME

## Annex 3: Agenda

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### Monday March 19, 2018

09:00 – 09:30 Opening, Introduction, Logistics, and Agenda Adoption (Maiju Lehtiniemi, Lidia Yebra, Sophie Pitois)

09:30 – 10:30 **ToR A)** Review the use of zooplankton production methodologies in collaboration with PICES BIO WG 37 (Lidia Yebra, Lutz Postel, Todd O'Brien)

WG 37 update – Lidia Yebra

Update production paper – Lutz Postel

WGZE biomass/production data compilation – Todd O'Brien

10:30 – 11:00 Coffee Break

11:00 – 12:00 **ToR B)** Compile data and provide expert knowledge and guidance in the definition of key traits of zooplankton species in the ICES area (Jasmin Renz, Todd O'Brien)

12:00 – 13:30 Lunch Break

13:30 – 14:00 **ToR B** (cont.)

Initiative on collecting trait data for the Baltic Sea and the FUNBAZOO (Functional Diversity of Baltic Zooplankton) project- Saskia Otto

14:00 – 15:00 **ToR C)** Recovery of "Dark Data" (datasets that are not available publicly) collected on or before WGZE time-series were started around 1990 - Peter Wiebe

Reconstructing Baltic Sea ZOOplanKtodynAmics: BAZOOKA- Piotr Margonski

15:00 – 15:30 Reporting from WGCHAIRS (Lidia Yebra, Sophie Pitois)

15:30 – 16:00 Coffee Break

16:00 – 17:00 **ToR D)** Macrozooplankton in mesopelagic zone (Antonina Dos Santos, Astthor Gislason, WebjornMelle)

Distribution and diversity mesopelagic fauna in selected seamounts of Northeastern Atlantic- Antonina Dos Santos

Trophic Relationships in the mesopelagic layers south west of Iceland- Hildur Pétursdóttir

### Tuesday March 20, 2018

09:00 – 10:30 **ToR E)** Analyze changes in the geographic distributions, seasonal patterns, and interannual trends of Arctic and North Atlantic macro- and meso- zooplankton species (Padmini Dalpadado, Todd O'Brien, Catherine Johnson)

Macrozooplankton (mainly euphausiids and amphipods) from the Barents Sea – Padmini Dalpadado

Results on macroplankton from Icelandic waters – Astthor Gislason

18 years of data of mesopelagic euphausiids in the W Mediterranean – Lidia Yebra

Mesozooplankton of the Canadian northwest Atlantic shelf: An atlas, key findings, and ideas for WGZE ToR E- Catherine Johnson (Presented by Todd O'Brien)

Pentadal ranking approach – Todd O'Brien

10:30 – 11:00 Coffee Break

11:00 - 12:00 **ToR E** (cont.)

Copepod trends in the coastal area of the southeastern Bay of Biscay during the period 1999–2015 – ArantzaIriarte

Can we compare zooplankton phenology across multiple ICES time-series sites? Mesozooplankton from L4, and Copepod phenology shifts from 4 ICES fixed points and CPR data – Angus Atkinson

Marine ecoregions of the southern North Sea: A zooplankton based approach- Eric Goberville

12:00 – 13:00 Lunch Break

13:00 – 14:30 **ToR F**) Gelatinous plankton – time-series collection, and recommendations regarding monitoring (Antonina Dos Santos, Tone Falkenhaus)

*Veillevella* off Portuguese coast – Antonina Dos Santos

Gelatinous monitoring strategy during IBTS survey – Elvire Antajan, Sophie Pitois

14:30 – 15:15 **ToR G**) Determine the status of microzooplankton time-series data collection within the ICES area (Elaine Fileman)

15:15 – 15:30 ASC 2018 theme session “Mesopelagic ecosystems: fish and invertebrate population biomass and biodiversity, and role in carbon flux” (Peter Wiebe, WebjornMelle, Antonina Dos Santos)

15:30 – 16:00 Coffee Break

16:30 – 17:00 **ToR H**) Review the applicability of continuous and real-time zooplankton techniques in long-term monitoring (JörgDutz, Peter Wiebe)

17:00 – Social even in SYKE meeting room

### **Wednesday March 21, 2018**

09:00 – 10:30 **ToR I**) Expand and update the WGZE zooplankton monitoring and time-series compilation (Todd O'Brien)

Progress in analysing the time-series of Dunkirk West 1993–2017 – Elvire Antajan

- 10:30 – 11:00 Coffee Break
- 11:00 – 12:00 Break out into ToR subgroups / side-meetings
- 12:00 – 13:30 Lunch Break
- 13:30 – 14:00 Discussion on 2019 theme sessions (Sophie Pitois, Lidia Yebra)
- 14:00 – 14:30 Planning for next Zooplankton Symposium (Sophie Pitois, Lidia Yebra) (R: Piotr)
- 14:30 – 16:00 Free discussion time
- 16:00 - Leave for quick tour of Helsinki on way to Sauna
- 17:00 - Sauna/Swimming in the city followed by Dinner.

#### **Thursday March 22, 2018**

- 09:00 – 09:30 Planning for next Zooplankton Symposium (Cont...) - Sophie Pitois, Lidia Yebra
- 09:30 – 09:40 Production paper issues – Lutz Postel
- 09:40 – 10:30 Break out into ToR subgroups / side-meetings
- 10:30 – 11:00 Coffee Break
- 11:00 –12:00 **ToR K**) Develop, revise and update of zooplankton species identification keys initially focusing on the most abundant taxa at the ICES time-series sites and ensuring their availability via the web, including especially ICES Zooplankton Identification Leaflets. (Antonina Dos Santos)
- 12:00 - 13:30 Lunch Break
- 13:30 – 14:00 Reporting by rapporteurs
- 14:00 –15:00 **ToR J**) Design and carry out coordinated and collaborative activities with WGIMT and WGPME (including the molecular/taxonomic tasks) (Elaine Fileman, Naiara Rodriguez Ezpeleta)
- ASC 2018 theme session “Molecules and morphology: integrative taxonomic analysis of marine planktonic assemblages” - Ann Bucklin, Lidia Yebra
- SCOR WG proposal: Metabarcoding zooplankton species diversity: global reference DNA sequence database (MetaZooGene) - Ann Bucklin
- 15:30 – 16:00 Coffee Break
- 16:00 – 17:00 AOB, Next Year venue and Timing, work plan and closure



## Annex 4: Additional information

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### **ToR a) Review the use of zooplankton production methodologies in collaboration with PICES BIO WG37**

**Lead: Lidia Yebra, Lutz Postel, Todd O'Brien; Rapporteur: Ann Bucklin**

WGZE coordination with PICES BIO WG37 is focused on reviewing the use of zooplankton production methodologies. Lidia summarized goals and activities for WG37 since the first meeting in Russia in September, 2017. These included producing review papers, including one in *Adv. Marine Biology*, and another in prep for submission. A paper on practical models for time-series based on Ikeda – Motoda methods will be presented at the upcoming PICES meeting in Japan. Todd is working to ensure inclusion of relevant data in COPEPOD, allowing global mapping on an interactive website. A network of laboratories is working collaboratively on this ToR. Lidia also listed several planned activities to be accomplished during 2018, including a workshop approved and funded for PICES 2018, which will address both conceptual and practical aspects and allow exchange of information and comparison and calibration of methodologies.

Lutz then reviewed recent work on a publication to calibrate zooplankton productivity and metabolic rates (previously WGZE ToR j); 2015–2017). Data from 18 time-series are being used to estimate zooplankton production using allometric approaches based on empirically derived formulas using both laboratory- and theoretically-derived measurements. The primary goal is to calculate individual specific growth rates, multiplied with biomass concentration. Results will be included in the Plankton Status Report. Lutz then explained the foundations of this work, with a careful and complete literature review. For the future, various new approaches will be considered, including the biomass increment technique, biomass difference method, and sampling theorem. Questions for Lutz included the recommended sampling frequency (answer: are frequent as possible, but no less than 3X the frequency you wish to analyse, based on the sampling theorem).

Todd then gave an update on building a database for biomass/production data, including equations, rates and measures. Since 2017, he has included equations into a database based on COPEPEDIA, determined data management of modifiers (i.e., ancillary information, such as life stage, month, year, and geographic location). In the near future, the database will store and serve biomass, Nitrogen and Phosphorus content, and rates. He is now working on including allometric, biometric, and environmental variables. He noted there is some overlap with data now available in COPEPODIA, which has >360 length-weight equations and >1300 individual biomass values. He described a use-case example based on biomass data for the copepods, *Calanus finmarchicus*, *Oithona similis*, and *Neocalanus similis*. He noted that the data aren't perfect. There is only one data record for *C. finmarchicus*, no standard relationship between dry mass and Carbon mass, poor quality control of outliers, inclusion of smaller life stages, and incorrect units. However, he concluded that the data are still useful at an order of magnitude level.

Todd added another topic to summarize work on Literature Databases for WGZE and several other ICES Working Groups. These were created out of necessity to handle references related to COPEPOD, since data providers frequently give incomplete / incorrect citations. The goal is to provide standardized links to online content, interactive search-

ing and listing. The PDF files are not publicly accessible if copyrighted, but can be accessed by Working Group members after login. Currently, the literature databases include ~350 references and <200 PDFs. WG members wishing to upload citations and files directly should send a request to Todd.

#### **Update on production paper by Lutz Postel *et al.***

The current stage of a publication on Calculations of zooplankton productivity and metabolic activity with special regard to the euphotic zone of the North Atlantic and adjacent seas was presented during the 2018 - Meeting of the working group. The calculation preferably based on individual specific rates obtained from mass scaling equations basing on both laboratory- and theoretically-derived measurements. This approach combines concurrent assessments of total mesozooplankton biomass and total abundance. Data from more than 20 time-series are the basis for the project. Calculated individual specific growth rates, multiplied by biomass concentration gives volume specific productivity and metabolism. A careful literature review allowed the evaluation of different equations. Both, accuracy and reliability of vertical distribution patterns was used as for the choice of the most appropriate attempt basing on data obtained in the entire water column during the ICES Gear inter-comparison in Storefjorden, Norway, 1993. In parallel, more simple attempts are in test basing on the course of standing crop within the growth season. This might become possible if data collection during the growth season followed the requirements of Nyquist sampling theorem.

#### **WGZE biomass/production data compilation - Todd O'Brien**

The term "biomass and production data" is used to describe measured information on the average size or biomass of individual zooplankton species and genera. Within the literature and experimental data, these data can be presented as an average value or as a range (e.g., minimum and maximum) or both. This information can also include length-weight equations, which allows one to estimate biomass when only a size is available.

This species-level biomass information is especially important when considering the ecosystem impact of changes in zooplankton species abundances. While the majority of WGZE time-series measure only species-level zooplankton abundance, this information may not fully indicate the magnitude of seasonal or temporal abundance changes. For example, without knowing their individual biomass, a "small" abundance change of +/- 50 *Calanus finmarchicus* may seem insignificant next to a "large" abundance change of +/- 1000 *Oithona similis*. In terms of biomass, however, that change in *C. finmarchicus* is actually double that of *O. similis*, as *C. finmarchicus* is five times larger than *O. similis* and weighs roughly 100 times more.

The initial 2016–2017 "biomass and production data" compilation effort was focused on gathering and putting these data into a common format and database. During the 2017–2018 period, this focus was expanded to test real-use application of the data compilation to WGZE time-series species abundances. During this testing, the importance of storing all the data in the same base-unit was found to be extremely important. While the original literature and experimental data values use units of either "milligrams" or "micrograms" for weights, the WGZE data compilation now converts all weight units to "micrograms". Doing this simple conversion "at load time", means that a user accessing

the data compilation does not need to check and convert different units before using the WGZE data compilation.

Work during the 2018–2019 period will continue to add new biomass and production data as well as identifying species in the WGZE time-series collection that currently do not have size or weight data in the data compilation. That list of missing/no-information species will then be used for additional literature searching or possibly to guide future field/lab work to measure these missing data.

ToR a) is also working cooperatively/collaboratively with the ToR b) zooplankton traits effort, as it is common for length and weight data to be included in the traits literature and data.

### **ToR b) Compile data and provide expert knowledge and guidance in the definition of key traits of zooplankton species in the ICES area**

**Lead: Jasmin Renz, Todd O'Brien; Rapporteur: Astra Labuce**

Traits are understood as heritable properties of the individual that are interrelated through trade-offs and selected by the environment (per definition after Brun *et al.* 2017). Furthermore, a criterion of measurability is applied and traits should be measurable on the individual without any assisting information (Violle *et al.*, 2007). In general, trait-based approaches are used to reduce the complexity of zooplankton in ecosystem models.

Litchman, Ohman and Kiørboe (2013) characterize traits according to their function and type with the function divided into feeding, growth and reproduction and survival and the type divided into life history traits, those belonging to behaviour, physiological and morphological traits.

Following aims of ToR b) were discussed to be fulfilled within the 3 year term: 1) to compile a database of known species-level zooplankton traits for the North Atlantic and adjacent seas; 2) to compile a "wish list" of key zooplankton species within the ICES area that are still missing some or all trait data; 3) to write a peer-reviewed publication on the methods and data of this compiled database.

Within the group it was discussed to spend year one pursuing following activities: assembling already existing work (papers and databases) to find the missing taxa groups and other holes (e.g. geographic, entire taxa groups) and create a literature / reference database to exchange papers and relevant documents

Three main databases on zooplankton traits that are available online could be identified so far.

- 1) A database by Benedetti, Gasparini and Ayata (2015) *Journal of Plankton Research: Identifying copepod functional groups from species functional traits*. This database includes functional traits of the most representative copepod species in the Mediterranean Sea for 191 species, described by 7 traits, which are minimal and maximal body length, trophic group, feeding type, spawning strategy, diel vertical migration and vertical habitat.

- 2) A database by Brun, Payne and Kiorboe (2017) Earth System Science Data: A trait database for Marine Copepods (includes Benedetti et al., 2015). This database includes planktonic copepods, mostly calanoids, some cyclopoids, harpacticoids, siphonostomatoids, with 9306 records for 14 functional traits, which are separated for different life stages when possible. Traits included are body size/mass (TL, mean, max, min), feeding mode, clearance rates, ingestion rate, spawning strategy, egg size, clutch size, fecundity, myelination, hibernation, resting eggs, respiration rates, growth rates, development duration and taxonomy.
- 3) A database by Hebert, Beissner and Maranger (2016) Ecology: A compilation of quantitative functional traits for marine and freshwater crustacean zooplankton. The database includes copepods (calanoids, cyclopoids), cladocerans from marine and freshwater habitats, with 8370 crustacean zooplankton trait observations, corresponding to 191 marine and 201 freshwater taxa. Traits included are zooplankton traits contributing to carbon, nitrogen, and phosphorus cycling. It includes traits on body stoichiometry and physiology based on the importance of zooplankton affecting individual energy fluxes and elemental processing (N, P and C content, N and P excretion rates and ratios, and respiration rates), species dry mass for mass-specific excretion and respiration rates. Dry mass estimates based on taxon-specific length-mass allometric equations are allowed and standardized temperature correction for zooplankton metabolic rates included.

Furthermore, Padmini Dalpadado introduced a (currently internal) database on zooplankton traits in the Barents Sea (BSECO), created by Marta Gluchowska and Padmini Dalpadado, that includes different zooplankton groups from the Barents Sea and currently has information about body size and weight, longevity, fecundity, life cycle, feeding mode, diet, habitat and biogeography. The establishment of the database is an ongoing project.

Angus Atkinson made the group aware of the 'Trait explorer', which is developed within the UK "Marine Ecosystems Programme" ([http://www.marine-ecosystems.org.uk/News/Trait\\_Explorer\\_traits\\_for\\_any\\_marine\\_species](http://www.marine-ecosystems.org.uk/News/Trait_Explorer_traits_for_any_marine_species)) and gives the option to explore traits obtained from existing databases (e.g., WORMS), published papers and new experiments. The Trait Explorer is a form of "automated expert judgement" that combines the taxonomic position of the species and any information on its traits, to provide the best possible estimate of all traits.

Another database includes data on individual size, mass and length-to-weight equations relationships and is currently created by WGZE member Todd O'Brien, available via the WGZE web portal.

Following data gaps were identified to be missing in available databases: The existing databases focus on calanoid copepods, other taxa, e.g. decapods, hydrozoans, mysids, euphausiids, are mostly missing. Some traits, as e.g. growth rates, clearance rates, reproduction frequency, vertical migration, motility or size at maturation are currently missing, at least in the available databases. Furthermore, in the existing databases the areas of origin are not explicitly mentioned, although available via references given in the datasets, therefore the data/taxa coverage within the ICES area needs a detailed analysis.

In a discussion within a subgroup it was discussed that a wish list of species and traits would be established via email to get an overview over the ecologically most abun-

dant/important species for the ICES area and the traits needed to characterize the communities. Traits to be included into this wish list might be individual size or length or volume info, length-to-weight regressions, individual biomass info (wet, dry, carbon, N or P content), vertical depth distribution and migratory behaviour (DVM, ontogenetic vertical migration), reproductive strategy (free spawning, egg sac carrying, resting eggs), feeding modes (herbivore, carnivore, omnivore, filterer vs. ambush), life rates (respiration, excretion, growth, generation time), biogeographic realms (e.g., arctic vs tropical, cool vs warm, etc.).

Firstly, the discussion about traits that are the most useful for modelers was brought up by Peter. The consensus was that size is a universal trait, yet importance of other traits depend on the aim of the study and data. Longevity, feeding mode and trophic role (herbivore vs carnivore) were mentioned as widely used as well. Angus pointed out the importance of type of plankton (holoplankton *vs.* meroplankton), whereas Jörg argued that rates are not traits as they are highly dependent on environmental factors. Secondly, the issue about 'dark data' was discussed and everyone agreed that recovering dark data might have a good impact on the database. And lastly, discussion about taxonomy as a trait began. Jasmin noted that an expert should decide on taxonomic level for analysis based on the traits added.

Following Todd's presentation, Maria wanted to know how the group can contribute to Todd's work, and Todd encouraged everyone to send the data to him, even if the data are unpublished, they can be added as 'dark data'.

Lidia and Saskia discussed the format of trait-based abundance database and the origin of trait characteristics for species. Saskia admits that for some traits information were not available from Baltic region research, so they used also information from the North Sea and other regions. Jörg again brought up the concerns about using rates as traits, but Saskia argued that they have created categorical groups based on the rate data range.

#### **Initiative on zooplankton trait database for the Baltic Sea – Saskia A. Otto**

In 2015, the short-term project "Functional Diversity of Baltic Zooplankton" (FUNBA-ZOO; funded by the federal state of Hamburg, Germany) was launched to develop a trait database for zooplankton species in the Baltic. The aim of the data collection was to support studies that explore the status quo of the diversity of functional traits in zooplankton communities in the Baltic Sea as well as potential long-term changes in the functional diversity and their key drivers. In marine, pelagic ecosystems, zooplankton plays a key role as it mediates the energy transfer between primary producers and secondary consumers, such as commercially important fish species. Strong contributions of zooplankton species to large-scale community shifts have been globally identified in the past years, also in the Baltic. Despite advances in identification and detection of trophic cascades and regime shifts in open and coastal ecosystems the coherence in timing between shifts in different basins and areas or the identification of key drivers underlying regime shifts and changes in key zooplankton species, several key questions remain unsolved, or are only partly addressed. These primarily concern understanding the potential changes in ecosystem functioning, particularly of key groups such as zooplankton. Despite their key role studies on functional diversity and trait dynamics have looked more into fish, benthos or phytoplankton than zooplankton communities. One of the main reasons is the lack of trait information for this group, particularly for non-copepod species. An initial

workshop served as platform to exchange knowledge on trait analyses, including gaps and pitfalls. Various general issues such as trait data collection, trait selection, data type of traits, etc. were discussed, a metafile of trait collections across all taxonomic groups assembled, and the implementation of a zooplankton trait database initiated. The relational database is slowly growing and contains mainly categorical traits (binary coded) or species observed in the zooplankton Baltic monitoring programs. The biggest challenges revealed so far are:

- the type of trait coding, i.e., whether continuous, categorical, binary or based on the fuzzy logic principles;
- the lack of continuous data (for e.g. physiological rates) across all zooplankton species;
- the lack of general trait information for non-copepod species;

To overcome these difficulties, a coordinated effort is needed beyond the Baltic Sea that includes taxonomic experts for the different micro-, meso- and macro-zooplankton groups.

#### **ToR c) Recovery of "Dark Data" (datasets that are not available publicly) collected on or before WGZE time-series were started around 1990**

**Lead: Peter Wiebe; Rapporteur: Solva Jacobsen**

Peter Wiebe presented an overview of the need to recover zooplankton data sets collected in the past that are not available in public open data repositories, but hidden on log books or computer hard drives and discs in investigators labs, etc. He presented a version of the WGZE recommended metadata for zooplankton samples that was created by the WGZE at the Gijón, Spain, 2003 and is in that year's report as "ANNEX 3: WGZE METADATA GUIDELINES FOR (ZOO) PLANKTON DATA". A doc file with a modified version of the guidelines was deposited in the WGZE Presentations SharePoint. He then reviewed the work he did to recover the "dark data" from his many cruises in the Northwest Atlantic and described in a recent paper [Wiebe, P.H., and Allison, M.D. 2015. Bringing Dark Data into the Light: A case study of the recovery of Northwestern Atlantic zooplankton data collected in the 1970s and 1980s. In special issue: "Rescuing Legacy Data for Future Science". *GeoResJ*. 6: 195–201. <http://dx.doi.org/10.1016/j.grj.2015.03.001>]. He showed how the data are now presented in the BCO-DMO data repository and how one can gain access to the data for download in a number of different formats (without need for a log-on). The metadata needed to define the Northwest Atlantic dark data zooplankton were presented as an example of the kind of information needed to document the data. He also presented a summary of a spread sheet provided by ICES, which was put onto the WGZE presentations SharePoint folder ("Simplified\_Format\_Communities\_PP-ZP-PB-ZB"), This format was prepared by ICES to assist investigators working in the Baltic Sea to provide zooplankton data to the ICES data repository. This format had a number of field descriptors some of which may not be needed to be completed in the process of dark data recovery. Although the original intent was to look for known data sets from past major zooplankton projects (such as TASC – Trans Atlantic Study of Calanus), a number of WGZE members have dark data sets that could

be a starting point for this ToRsthree year effort. Piotr Margonski has already started this endeavour and gave a short talk of his effort (Abstract below).

#### **Reconstructing Baltic Sea ZOOplanKton dynAmics: BAZOOKA – Piotr Margonski**

A small project “Reconstructing BALtic Sea ZOOplanKton dynAmics” (BAZOOKA) was funded by the European Network of Excellence for Ocean Ecosystems Analysis (EUR\_OCEANS) Funding Programme for data rescue and integration in 2007. Project was coordinated by the University of Hamburg (UHH) with three other institutions participating: Tartu Uelikool, EestiMereinstituut (MEI), Sea Fisheries Institute (MIR), and Latvian Fish Resources Agency (LATFRA). The project was focused on rescue historical zooplankton abundance and biomass data from 2 different areas of the Baltic Sea, i.e. the open Central Baltic and the Gulf of Riga. Piotr Margonski presented part of the work done at MIR. Numerous historical zooplankton research carried out at MIR are documented in a form of publications and reports. Unfortunately, most of those historical data are in ‘paper’ version only. More than 20 different sources of information were identified. In most of the cases there were tables and figures that needed to be reformulated into to the useful database format. Identified sources were covering different time periods that some of them were going back to 1930s. Different sampling gears were used: Nansen, Hensen, Copenhagen, and WP-2 nets as well as water samplers.

At the end of the project the data file consisted of more than 15 thousands records and has been offered to be used within the ToR c) Recovery of "Dark Data".

#### **ToR d) Macrozooplankton in mesopelagic zone**

**Lead: Antonina Dos Santos, Astthor Gislason, Webjorn Melle; Rapporteur: Padmini Dalpadado**

Astthor Gislason highlighted the importance of the mesopelagic zone in the background information document submitted to ICES in support for this ToR. The mesopelagic zone constitutes a huge biomass. Earlier work shows ca. 1 billion tons wet weight of mesopelagic fish biomass globally. Recent estimates are 10 times larger as net avoidance tends to underestimate catches. Mesopelagic organisms are important conveyers of mass and energy into deeper waters. Diurnal migration and sound scattering layers are characteristic of the mesopelagic zone. Two new publications have characterized the biogeography of mesopelagic zones (200–1000m); (Sutton *et al.* 2017; Proud *et al.*, 2017). One based on acoustics and the other on environmental proxies such as primary production, salinity, temperature, and oxygen levels. It was stressed that much is unknown about the mesopelagic community and its functioning, especially the role of macroplankton taxa. Hence, it is very important to address the role of macroplankton in the mesopelagic zone. The use of novel technology such as specially designed submersible transducers, optics, better trawls are considered, and several new projects are underway.

Deliverables from ToR d) will be to address key issues such as taxonomy, biomass, trophic ecology, reproductive biology, and carbon flux. The aim is to produce a summary publication.

Data from Reykjanes ridge and Irminger Sea mesopelagic zone were also presented. The main organisms observed were jelly fish, shrimps, euphausiids, and small mesopelagic fish. Diurnal migration of the mesopelagic organisms was evident during these cruises.

Discussion: Peter Wiebe said that there should be higher biomass of mesopelagic zooplankton than fish, yet we know very little. Peter also mentioned that Woods Hole Oceanographic Institution is making a new towed acoustic body.

Tone Falkenhaus stressed the importance of using several approaches when studying the mesopelagic organisms (nets/trawls, optical and acoustic techniques) as none of the gears are optimal for catching quantitatively representative samples.

Webjørn Melle informed that using bigger gear e.g. larger trawls (800 m<sup>2</sup> opening) with relatively small mesh sizes (3 or 10mm mesh size) reduces avoidance, hence can catch representative samples.

Peter informed that strobe lights could be used to get better catches of euphausiids. The importance of obtaining vertical distribution of biomass was pointed out by Webjørn-Melle.

Astthor drew the attention of the group to the MARECO study, with a cruise from Iceland and to the Azores islands, where the main aim was to study biodiversity over the Reykjanes Ridge with sampling from the whole water column using combined gears. Results are highly relevant to the present work and are published in a special volume of Deep Sea Research (2008).

#### References

- Proud R, Cox MJ & Brierley AS (2017) Biogeography of the Global Ocean's Mesopelagic Zone. *Current Biology* 27, 113–119.
- Sutton TT, Clark MR, Dunn DC, Halpin PN, Rogers AD, Guinotte J, Bograd SJ, Angel MV, Perez JAA, Wishner K, Haedrich RL, Lindsay DJ, Drazen JC, Vereshchaka A, Piatkowski U, Morato T, Błachowiak-Samotyka K, Robison BH, Gjerde KM, Pierrot-Bults A, Bernal P, Reygondeau G & Heino M (2017) A global biogeographic classification of the mesopelagic zone. *Deep Sea Research Part I: Oceanographic Research Papers*, 126: 85–102.

#### **Distribution and diversity mesopelagic fauna in selected seamounts of Northeastern Atlantic – Antonina Dos Santos**

Mesopelagic fauna of three NE Atlantic seamounts (Gorringe Bank, Josephine and Seine) was sampled using an Isaacs-Kidd Midwater Trawl (IKMT) and acoustic records (EK-500 with 38 k), during a survey conducted from August- September 2016. A total of 98 taxa were identified: 52 crustaceans, 34 fish, 6 molluscs and 6 gelatinous organisms, belonging to 37 families. Multivariate analyses, based on presence-absence data, did not show significant differences among seamounts, day and night or position on the water column, neither detected seamount effect. However, some influence of the three NE Atlantic seamounts studied on the mesopelagic community was detected because higher biodiversity was found in oceanic waters compared to seamounts. In this work, the acoustic signal produced by mesopelagic organism was weakly detected by the echo sounder, probably due to a low level of aggregation of the mesopelagic resonant organisms. Echogram scrutiny suggests a diel vertical migration of the mesopelagic fauna.



Discussion: Lidia Yebra mentioned that it was surprising that the higher biodiversity was observed in oceanic waters. Antonina confirmed that this was expected for the region.

Peter and Webjørn pointed out that the weak scatters seen in the echogram could be due to not adjusting threshold levels.

Peter asked whether the seamounts were submerged. Antonina informed that all 3 seamounts are submerged, being the Gorringe Bank the one that has the summit near de surface, 35 and 50 m depth.

Maria Grazia Mazzocchi inquired whether the seamounts were volcanic. According to Antonina there is no known volcanic activity in the region, despite they are probably of volcanic origin.

#### **Trophic Relationships in the mesopelagic layers south west of Iceland – Hildur Pétursdóttir**

Trophic relationships in the mesopelagic zone in the Mid Atlantic Reykjanes Ridge, South of Iceland, were presented. This region is characterized with high primary production, zooplankton biomass and fish diversity. This is also an important nursery and feeding ground for red fish. Stable isotope technique and fatty acids were used to structure trophic interactions of the mesopelagic organisms. The isotopic and fatty acid methods reflect dietary assimilation for longer periods than the traditional stomach content analysis. *Calanus finmarchicus* was used as a base. Two trophic pathways were observed, one via *C. finmarchicus* to mesopelagic organisms and the other with krill to red fish.

Another investigation was aimed to explore species composition in the mesopelagic layer east of Iceland. A macroplankton trawl was used to obtain samples. Species composition was resolved into several groups, including small mesopelagic fish. Species composition and abundance levels were compared in cold (west region) and warmer waters (east region). Amphipods and chaetognaths contributed more to the biomass in more colder waters whereas euphausiids composed a major part of the biomass in warmer waters. Of the amphipods the Atlantic species *Themisto abyssorum* dominated in numbers except at the coldest station where the arctic species *T. libellula* dominated. Of the krill species *Meganyctiphanes norvegica* where in highest numbers in all study area.

Discussion: Webjørn asked whether *M. norvegica* fed on *Calanus* spp. Hildur informed that *M. norvegica* is known to feed on *Calanus* spp., however, such feeding was not much evident from her study and that the feeding mode may vary seasonally.

Maria Grazia asked about the stepwise enrichment used in the positioning of trophic level. Hildur informed that the values were taken from literature; they also fit well from her previous observations from stomach content analyses.

Janna Peters stated that there are not many alternatives to these methods (FA and SI), however, both methods very often only give a rough idea of the food web structure. Angus Atkinson responded by stating that compound specific isotope analysis is the best to use. Hildur stated that all methods have limitations and that the best approach is to use combination of methods.

**ToR e) Analyze changes in the geographic distributions, seasonal patterns, and interannual trends of Arctic and North Atlantic macro- and meso- zooplankton species**

**Lead: Padmini Dalpadado, Todd O'Brien, Catherine Johnson; Rapporteur: Marc Ringuette**

The objectives and topics of ToR e) came about from the research interests and questions of multiple WGZE group members and a long-running suggestion to expand the Plankton Status Report analysis into species-level research and peer-reviewed papers. This ToR has both “macrozooplankton” and “mesozooplankton” elements, co-led by Padmini Dalpadado, Todd O'Brien, and Catherine Johnson. The initial goals for the first year of this three-year ToR were (1) to identify and compile available species-level data from WGZE time-series programs, and (2) to apply initial, exploratory analysis on the data to identify the target species groups and analytical methods for the study.

This ToR will investigate the changes in the geographic distributions, seasonal patterns, and interannual trends of Arctic and North Atlantic macro- and mesozooplankton species. Todd/Catherine are coordinating the mesozooplankton work whereas Padmini will coordinate the macroplankton work. Time-series on macroplankton (euphausiids, amphipods, chaetognaths etc.) from the ICES regions will be mapped and explored in this context. Padmini presented the time-series macroplankton (krill & amphipods) from the Barents Sea Ecosystem.

**Macrozooplankton (mainly euphausiids and amphipods) from the Barents Sea - Padmini Dalpadado**

Barents Sea is experiencing substantial changes. The ice cover has reduced drastically over the years with 2016 having the minimum cover since 1951. Simultaneously the area of Arctic water has decreased drastically with 2016 having the minimum area. The increase in temperature conditions, and decrease in sea ice cover, have led to large ice-free areas especially in the north and east, hence higher integrated phytoplankton production in the Barents Sea. Euphausiids, which are Atlantic boreal species, are likely favoured by increase in temperature, expanded areas of the Atlantic and mixed water masses and good feeding conditions. The long-term Russian data series seem to indicate that the euphausiid abundance in the last decade is higher than the 3 previous decades. Emergence of *Meganyctiphanes norvegica* since the 1990s, likely has contributed to biomass increase of euphausiids. On the contrary, the Arctic amphipod biomass has decreased over years. These changes are likely to impact on the Barents Sea food web. As the work of ToR E progresses, we intend to conduct regional comparisons.

Discussion:

Q : What kind of nets are used ?

A :Essentially Moccus and bottom trawl with a meshsize of 500 micron.

Q : What is the fish predatory impact on Amphipod regarding its downward trend? A : Fish are switching to the more abundant Krill and Polar cod population also decreasing.

### Recent studies on abundance and trends in euphausiids off Iceland – Astthor Gislason

The presentation describes recent projects designed to improve knowledge of the distribution and abundance of euphausiids around Iceland, and efforts in developing an acoustic monitoring survey for euphausiids around the island. In May, euphausiids are more abundant in south and west of Iceland than in north and east. Distribution of eggs and larvae indicates that the main spawning of *Meganyctiphanes norvegica* is taking place off the south and west coasts. Length frequency distributions and population structures indicate a life span of 2-years for *M. norvegica* while 1-year for *Thysanoessa inermis*. Studies to estimate abundance of *T. raschi* were carried out in Isafjord-deep in 2012–2013, a fjord on the northwest coast of Iceland, using acoustics, net/trawls and Video Plankton Recorder. Since 2011, acoustic studies for euphausiids have been part of the annual Icelandic spring monitoring survey. Backscatter from euphausiids tends to be relatively high over shelf edges and sub-marine valleys. Analyses of the acoustic backscatter at different frequencies indicate that euphausiids are generally larger south of Iceland than in north and east, which is in accordance with results from net tows and trawls, showing that the relatively large euphausiid *M. norvegica* is most abundant in south and west, and the smaller *T. inermis* in north and east. Analysis of backscattering values for whole series (2011–2017) by time of day showed limited diel variability in the oceanic areas, with great interannual variability in backscattering strength. Further work will include exploring both bottom-up and top-down effects on euphausiid abundance and development.

#### Discussion:

Q : Are the acoustic survey around Iceland to be continued in the future?

A : Yes

Q: Is their plans to commercially harvest krill in Iceland ?

A : Potentially. There is exploration permit allocated with low quotas. Industry is working on the processing aspect and finding potential markets/news products.

Q : Have you tried to estimate abundances using the model.

A : Not yet, but it is but it is in the future work plan.

Q : What is the length of the cruise?

A : 2–3 weeks.

Comments... Instrumenting a glider with acoustic would provide a more extensive spatial coverage with less effort.

### 18 year (1994–2012) data of mesopelagic euphausiids in the W Mediterranean – Lidia Yebra

MEDITS is an international program, within the Data Collection Framework, consisting on annual bottom trawl surveys in the Mediterranean Sea from 1994. Member States include France, Italy, Greece, Spain, Malta, Slovenia, Croatia, Montenegro, Albania and Cyprus. Research surveys are carried out by all countries with the same sampling methodology, during summer, with the objective of evaluating the abundance and distribution of stocks, independently of the data provided by commercial fisheries, and assessing the impact of fishing activity on the environment. In these cruises, all species captured (including non-target species) are identified and counted, and their weight measured. The first 18 years of survey in Spanish waters provide an indirect assessment of the verti-

cal and spatial distribution of the euphausiid species *Meganyctiphanes norvegica*. Results show its preference for mesopelagic waters, with 60% of the organisms captured between 200–500 m, and 25% between 500–800 m depth.

Discussion:

Q : Is there corresponding acoustic data?

A : No, not for this program. Acoustics is done on the pelagic fish survey later in summer.

**Mesozooplankton of the Canadian northwest Atlantic shelf: An atlas, key findings, and ideas for WGZE ToR e) – Catherine Johnson (Presented by Todd O'Brien)**

An introductory presentation of Catherine Johnson (given remotely) helped further develop and outline the study questions for this ToR: What are the changes in species composition and spatial distribution, are there changes in the seasonal timing of the dominant/subdominant species or functional types, and are there common or contrasting patterns of change across the North Atlantic (ICES regions).

**Pentadal ranking approach – Todd O'Brien**

Todd and Catherine presented a “rank-based” spatial analysis which summarized changes in the dominant and subdominant copepod taxa over different time periods and seasons in the Gulf of Maine and Scotian Shelf regions. While the average annual structure of the copepod community stayed fairly stable over the last 15–30 years (1987–2016 or 2002–2016), large changes were seen in the last 5 years (2012–2016). For example, *Calanus finmarchicus*, a cooler-water preferring copepod, went from consistently being in the top-three most abundant copepods to falling to seventh place or even completely out of the top-ten taxa. This period of change (2012–2016) was also a period of record high water temperatures in the study region. Looking at individual months, there were also clear seasonal periods in which these changes may be attributed.

The initial results of this small trial analysis were promising. Over the next two years of this ToR, the analysis will be expanded to look at the full ICES-WGZE (trans-Atlantic) region additional geographic areas, and to also include non-copepod taxonomic groups and macrozooplankton.

Discussion:

Q : Could it be link to something else than temperature?

A : Would be interesting to investigate as long as we have a long enough time-series of copepod composition. This is a work in progress that will evolve as we go. What will be need is the full species composition when available. Otherwise at least dominant and sub-dominant taxa and at the end, we will have to aggregates in some ways for the inclusion of some less precise dataset.

Q : It will be a huge task to convert these abundance in biomass?

A : That is where TOR a) and TOR b) comes into play.

Q : Will you send a standard format for the data?

A : Whatever you have I will make it work.

Q : Is there a minimum number of sampling per year?

A : No

Q : Including CPR?

A : They say we should do the analysis ourself. But perhaps on the long run we would be able to get at least a ranking of the dominant species.

Q : Will there be participation from the Baltic?

A : There is no exclusion zones.

**Copepod trends in the coastal area of the southeastern Bay of Biscay during the period 1999–2015: preliminary results – Fernando Villate, Arantza Iriarte, Ibon Iriarte, Ziortza Barroeta**

Results of a preliminary analysis of trends in the main copepod species of shallow, near-shore coastal waters of the Basque coast (southeastern Bay of Biscay: Bilbao 35 and Urdabai 35 sites) carried out for the period 1999–2015 have been presented. The influence of environmental factors such as temperature, salinity, chlorophyll a and upwelling index was also assessed. Trends of increase were identified for the abundance of some spring peaking species such as *Acartia clausi* and *Oithona similis* and interannual variations correlated positively with upwelling index and salinity. In contrast, the abundance of some summer or early autumn peaking species, such as *Corycaeus anglicus*, *Oithona plumifera* and *Temora stylifera* showed trends of decrease over the study period and summer water temperature and summer chlorophyll a concentration were the factors that best correlated with their year to year abundance variations. Other species, i.e. *Temora longicornis* and *Oithona nana* seem to have been increasing their abundances over the study period, but the environmental factors tested could not account for the observed increases. Other copepod species showed no significant trends.

Discussion:

Q : How did you define Up welling index.

A : Essentially Ekman transport.

Q : Is there a changes observed in the phenology?

A : No clear trends in the study period, but there is some variation, but not necessary at the species level.

Q : Do you encounter South Atlantic species especially during high upwelling years?

A : Maybe yes, but the taxonomic resolution does not allow for this kind of discrimination since we are only looking at the dominance. They would have to be of a substantial abundance to be catch by the method.

**Can we compare zooplankton phenology across multiple ICES time-series sites? – Angus Atkinson with contribution from Tim Smyth (Plymouth Marine Laboratory)**

This presentation provides firstly an update on the Plymouth L4 station which has just reached its 30th anniversary of weekly-resolved measurements. Secondly I made the suggestion that we can benefit from the excellent network of ICES time-series site to provide a unified understanding of phenology shifts. I first provided some summary plots of the

time-series sites to show that we had recently provided some “value-added” to the existing time-series of abundance (~180 taxa) by adding a series of traits, namely max body size, mean carbon mass, seasonal carbon mass and categorical traits (e.g. meroplankton versus holoplankton, large versus small copepods) that had been used as lifeform codings for MSFD and OSPAR. These will be made available for the traits ToR. These time-series show for example the important biomass contribution of meroplankton, gelatinous taxa as well as copepods. The copepods show cyclicity and possibly a decreasing trend whereas several gelatinous taxa have increased. I then provided an overview of the opportunity provided of combining time-series to provide a meta-analysis of species and latitude-related changes in phenology. This is tractable but requires some decisions on which time-series to include the scope of the analysis (for example which taxa to include) and some other practical details.

Discussion:

Q : With the same data set combining time-series could answer different question on timing and phenology as well as trends in abundance and dominance.

Q : Is *Pseudocalanus* a mixture of species?

A : It probably is and but hope is one species is overly dominant and the others does not have a major impact on the trends.

**Marine ecoregions of the southern North Sea: A zooplankton based approach – Eric Goberville, Dorothée Vincent, Cyrielle Bandura, Nicolas Spilmont, Cindy van Damme, Elvire Antajan**

One of the main challenges of marine biogeography is to identify how biodiversity is organised and how distributional patterns are modulated by environmental conditions. While past attempts in identifying representative marine ecoregions have been mostly based on the use of physical and chemical factors at large scale (e.g. the Longhurst provinces), defining ecological patterns at a finer spatial scale is now required to better understand ecosystem responses to rapid environmental changes. Particularly sensitive to hydro-meteorological changes, zooplankton species are known to mirror ecosystems conditions, and modifications in community composition/abundance are often related to changes in ecosystems structure and functioning. Using zooplankton species as indicators of changes appears therefore particularly appropriate to examine how fluctuations in environmental conditions may influence an ecosystem as a whole. Here, we used data from an ichthyoplankton survey conducted monthly from April 2010 to March 2011 in the southern North Sea. While this survey was initially dedicated to fish eggs and larvae, main mesozooplankton groups (collected with a Gulf VII high-speed sampler) were identified a posteriori using the ZooScan, an integrated analysis system for acquisition and classification of digital zooplankton images. Following this analysis, coastal marine ecoregions of the southern North Sea were determined seasonally, by combining both a hierarchical clustering procedure and a nonparametric probabilistic approach. For each season, we then characterised within-ecoregion diversity as well as the relationships with environmental conditions. Such an approach is essential to improve current knowledge on the structure and dynamics of ecosystems and appears as a relevant source of information to support management decisions.

## ToR f) Gelatinous plankton – time-series collection, and recommendations regarding monitoring

**Lead: Antonina Dos Santos, Tone Falkenhaus; Rapporteur: AgataWeydmann**

During the presentation of ToR f) “Gelatinous plankton time-series collection, and recommendations regarding monitoring” by Antonina Dos Santos and Tone Falkenhaus, the Working Group discussed which taxa should be included into the category of gelatinous zooplankton. The definition of gelatinous plankton usually applies to Cnidaria and Ctenophora, sometimes also Tunicata (Salpida, Doliolida, Appendicularia). The doubts from the audience were mainly connected to Chaetognatha that had not been included in the presentation, but after the discussion, the leader of ToR f) agreed to include chaetognaths into the category of gelatinous plankton. The talk finished with the request to the group members to provide an inventory of existing gelatinous plankton time-series in order to compile metadata on the available datasets, as well as to propose and revise methodologies used for sampling these organisms.

Furthermore, the importance of citizen science and new methods in studying gelatinous organisms was emphasized. There is a couple of on-going, or recently finished, projects and programs that involve non-scientists in helping to collect data, e.g. in Finland this method is used to monitor moon jellyfish *Aurelia aurita*, as Maiju Lehtiniemi reported. In the Bay of Naples, the medusas are going to be monitored with the use of drones, what can provide more actual data than selective sampling with the use of traditional sampling gears.

Both approaches were combined in the study of *Vellela vellela*, recently published in Marine Ecology Progress Series by Pires *et al.* (Pires RFT, Cordeiro N, Dubert J, Marraccini A, Relvas P, dos Santos A (2018) Untangling *Vellela vellela* (Cnidaria: Anthoathecatae) transport: a citizen science and oceanographic approach. Mar Ecol Prog Ser 591:241–251), in which different methods, including the experiments with ecological floatings (oranges) and drifting buoys, as well as GelAvista citizen science program were used. The information and methodology presented in this study could be used for species with similar habitat preferences and biology, e.g. Portuguese man o’ war, *Physalia physalis*. The problems connected to the latter species were discussed after the question of Padmini Dalpadado if *Physalia physalis* is becoming more common in the Portuguese waters or is it just the lack of knowledge. In both cases, the use of citizen science can help to provide new information for the science and awareness on the Portuguese man o’ war blooms in the society.

A similar idea stayed behind the work of Elvire Antajan and Sophie Pitois on gelatinous monitoring strategy during the IBTS fisheries surveys, as jellyfish constitute a large proportion of the fisheries bycatch, although they had not been officially reported for years. The discussion after the presentation started with a question of Piotr Margoński if there is there any person onboard, who is responsible for the identification of gelatinous plankton, or is it the additional activity of fishermen. The response was that the fishermen were “nicely convinced”, trained to identify jellyfish and supplied with a helpful guide for determination of main gelatinous zooplankton species onboard, and some are even eager to do it now, but there is still a need to involve more people in this task. Tone Falkenhaus asked if there were plans or any cooperation with other IBTS countries and it

seems that a number of studies include jellyfish now but unfortunately, they are usually not dedicated specifically to the gelatinous zooplankton.

The overall conclusion of this session was that it would be ideal to establish one, common and specifically dedicated method of collecting gelatinous zooplankton as well as to involve non-scientists e.g. through citizen science and/or fishermen in data collection.

***Verella verella* (Cnidaria: Anthoathecatae) transport: using a citizen science program and oceanographic data (2018, Mar Ecol Prog Ser, 591: 241–251) Rita F. T. Pires, Nuno Cordeiro, Jesús Dubert, Alessandro Marraccini, Paulo Relvas and Antonina Dos Santos**

*Verella verella* is a pleustonic colonial organism found in temperate and tropical oceanic waters worldwide. Zooplankton samples collected off the northwestern Portuguese shelf during a spring oceanographic survey revealed considerable abundance of *V. verella* specimens, mostly in the pelagic phase. Drifters released in the sampling area were remotely followed to examine surface currents, and current velocities were registered, allowing the characterization of the oceanic conditions in the region. Sightings of *V. verella* collected through the 'GelAvista' program, a Portuguese citizen science initiative, were used complementarily, and provided important indications on periods of high abundance and probable areas of occurrence. Local wind regimes were the main driver of *V. verella* distribution and onshore transport, taking into account the direct exposure to the wind and surface circulation variability. The observed occurrences followed the predominant local alongshore currents and are discussed according to local ocean dynamics, enhancing the knowledge on the at-sea ecology of these organisms.

**Monitoring gelatinous zooplankton: a cost-effective methodology during routine fishery trawl surveys – Elvire Antajan, Sophie Pitois**

Gelatinous zooplankton, including cnidarians, ctenophores, and tunicates (appendicularians, pyrosomes, salps and doliolids), are often overlooked by scientific studies, ecosystem assessments and at a management level. Despite the important economic consequences that they can have on human activities and on the marine foodweb, arguments often related to the costs of monitoring have resulted in the absence of relevant monitoring programs. A cost-effective protocol has been applied on trawling from existing fishery surveys conducted by CEFAS in England and IFREMER in France. The testing phase has successfully demonstrated the adequacy of such a tool to sample macro- and mega-zooplankton gelatinous organisms in a cost-effective way. This success has led to the acceptance of this protocol into the French implementation of the EU's Marine Strategy Framework Directive (MSFD). Results of the testing phase and the detailed protocol which can be applied to any trawl-based fishery survey and in any new large-scale monitoring program were published in Marine Policy journal (Auber *et al.* 2018). However, a clear consensus is still to be found on the calculation of the trawl volume necessary to express gelatinous zooplankton abundance, if a shared international protocol is to be used



**ToR g) Determine the status of microzooplankton time-series data collection within the ICES area.**

**Lead: Elaine Fileman; Rapporteur: Saskia Otto**

Microzooplankton comprise heterotrophic protozoa and metazoa <200µm this includes heterotrophic flagellates, dinoflagellates, ciliates, foraminifera, rotifers, copepod eggs and nauplii, some copepodites, and some meroplanktonic larvae. Their fast growth rates enable them to respond rapidly to increases in their food. Grazing by microzooplankton significantly impacts bacterial and primary production and usually exceeds that of mesozooplankton. In addition microzooplankton are important nutrient recyclers and contributors to the diet of higher trophic levels. The role of microzooplankton in the marine food web was previously reviewed by the WGZE as a ToR in 2007 and their findings were discussed in the annual meeting in Riga, Latvia. The group at that time decided that WGZE should include both micro- and meso-zooplankton experts and that microzooplankton time-series and monitoring should be encouraged in the ICES area. The purpose of this current ToR, therefore, is to assess progress made in this area over the last ten years, and identify collaboration, gaps or overlap with other expert groups. Prior to the meeting, a survey on microzooplankton time-series was circulated to all WGZE and WGME members; responses received to date were collated and presented but it is anticipated that more responses will be received over the coming months.

The ToR presentation was followed by questions regarding the underlying sampling design for the sampling gear and mesh size comparison which was presented. A key finding in the presented study was the effect of mesh size (e.g. 63µm *vs.* 200µm) and gear type (e.g. net *vs.* Niskin bottle) that can lead to differences in sampled micrometazoa by a factor of > 1500. However, some of the differences between gear type were discussed to be artefacts of potentially different mesh sizes. The overall recommendation of net mesh size for microzooplankton was 20µm, although for delicate protozoa water bottles are the preferred method of sample collection. A mesh size of 10µm could easily lead to clogging, whereas 63µm makes quantification of smaller species less robust. A quick poll of participants revealed that some microzooplankton groups such as rotifers and copepod nauplii are already quantified and reported, e.g. in the HELCOM monitoring program, which could be shared and listed in the ToR overview table. A common agreement was also made in terms of the relevance and inclusion of copepod eggs in monitoring programs and analyses. Some countries like the U.S. or UK already quantify eggs, while other countries such as the Baltic Sea states do not. In terms of species identification, automated imaging technology such as the FlowCAM can be also used for microzooplankton as done by PML. Their experience of species recognition from these images is pretty good although it still requires a taxonomist to cross-check and analyse the results.

**ToR h) Review the applicability of continuous and realtime zooplankton techniques in longterm monitoring**

**Lead: Jörg Dutz, Peter Wiebe; Rapporteur: Eric Goberville**

ToR h) provided an overview on the present real-time zooplankton sampling techniques/sites and presented suggestions for the focus of recommendations for the implementation of these techniques into long-term time-series. A number of time-series sites

presently using real-time methods were identified and highlighted in the presentation by Peter Wiebe. Most sites use imaging systems. The Zooplankton Laboratory of the Oceanographic Observatory in Villefranche sur Mer regularly provide sample data from WP2 nets using Zooscans within a few days of collection. Real-time imaging techniques are also used by Martha's Vineyard Coastal Observatory using the Imaging FlowCytobot, the Scripps Plankton Camera (SPC) deployed into the Southern California Coastal Ocean Observing System (SCCOOS), the Cabled Observatory in Japan is using an underwater microscope camera in a bottom mounted profiling system, and the LiZa in flow system has been used on the Atlantic Meridional Transect cruises by Culverhouse *et al.* (2015). Other real-time techniques include bio-acoustics sonars implemented on autonomous platforms or gliders (e.g., the ocean observatory initiative on Georges Bank and Gulf of Maine, the Oceanographic Autonomous Observations by the The French National Center for Scientific Research) as well as the custom made semi-automatic samplers (CALPS) collecting zooplankton via pumps to be analyzed by imaging systems. Recommendations regarding the applicability of imaging techniques or acoustics to long-term study sites should address the needs for quantitative data and specificity for biodiversity analysis, the advantageous and limitations of the techniques (size, sampling volume) and technical advice for the implementation.

Sophie Pitos provided details of a system still in development but designed to work in real or near real time. In October it will be tested with a new laser camera, which should increase the resolution and quality of the images. It will produce colour images so it may be applied to measuring plastic particles. Details are provided in:

Pitois, S.G., Tilbury, J., Bouch, P., Close, H., Barnett, S., and Culverhouse, P.F. 2018. Comparison of a Cost-Effective Integrated Plankton Sampling and Imaging Instrument with Traditional Systems for Mesozooplankton Sampling in the Celtic Sea. *Frontiers in Marine Science*. <https://www.frontiersin.org/article/10.3389/fmars.2018.00005>

also for real time application:

<https://www.youtube.com/watch?v=Fe01CTjBxM0&feature=youtu.be>

Mark Benfield provided input via email about the software being used for zooplankton image identification, Everyone seems to be going it alone. ZooImage hasn't been updated and it was the more or less most generic of the software out there. Fluid Imaging Technologies have adapted their FlowCAM software to several of their imaging systems (including one for my ZOOVIS system) but it's slow and the classification capabilities are limited. Hongsheng Bi *et al.* have developed a software package that does thresholding and classification. It should be quite adaptable to other systems.

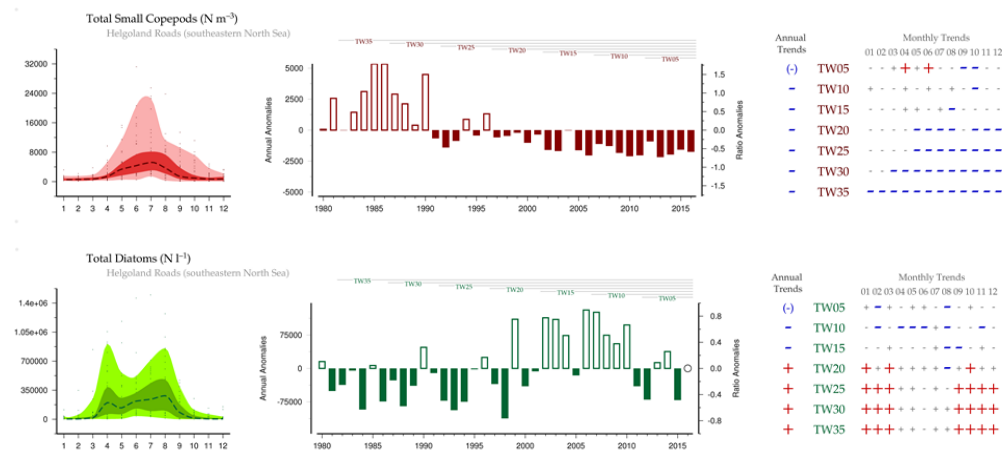
Partial list of software programs for zooplankton image identification:

- ZooImage
- FlowCAM software VisualSpreadsheet™ software
- Bi *et al.* thresholding and classification (Benfield per com)
- Plankton Identifier is a free software [http://www.obs-  
vlfr.fr/~gaspari/Plankton\\_Identifier/index.php](http://www.obs-vlfr.fr/~gaspari/Plankton_Identifier/index.php)
- PIA classifier (Culverhouse, P.F., Gallienne, C., Williams, R., Tilbury, J. 2015. An Instrument for Rapid Mesozooplankton Monitoring at Ocean Basin Scale. *J Marine BiolAquacult* 1(1): 1–11.)

**ToR i) Expand and update the WGZE zooplankton monitoring and time-series compilation**

**Lead: Todd O'Brien; Rapporteur: Jasmin Renz**

Todd O'Brien gave an update on the progress of the joint WGZE/WGPME ICES Plankton Status Report (PSR). Unfortunately, this report was delayed for a full year due to Todd and WGZE's heavy participation in a global time-series status report created by the IOC-UNESCO International Group for Marine Ecological Time-series (IGMETS). WGZE and WGPME time-series and authors contributed heavily to the report in both data and writing, representing over 50% of the global time-series contributions, and over 90% of those in the North Atlantic). Now that this IGMETS report is completed, Todd and the WGZE/WGPME authors can now focus on the ICES PSR.



The good news was that, during this IGMETS delay, Todd developed a new WGZE/WGPME analysis and graphical presentation for the “PSR-2018” report’s expansion into a month- and season- based analysis. For example, the new method figures above summary small copepod and diatom abundances at the Helgoland Roads time-series site. The left sub-panels show their seasonal cycles, the middle sub-panels show their annual anomalies (from 1980–2016), and the right-side matrices summarize the annual and monthly trends within the data over multiple time windows ranging from 5 to 35 years (TW05, TW35). Summarizing the figures, copepods at Helgoland Roads were decreasing while diatoms were increasing up until the last 15 years. The month-based analysis of the diatoms (right-side matrix) shows that this increasing 20–35 year annual trends (e.g., TW20-TW35) were actually due to strong increases in the non-summer months (e.g., September – March), while the more recent decreasing trends are not really attributed to a single season.

Todd explained the new method for calculating the anomalies and figures shown above. The IGMETS “time window” analysis will be used in this report, with trends calculated for 5-year incrementing intervals (e.g., 5, 10, 15, 20, .. , 35, aka “TW05”, “TW10”, ... “TW35”). To qualify for a time window, at least 80% of the years in that window must have data present. Within the report, spatial analyses will look at trans-Atlantic trends over the last 10-, 20-, and 30- year time windows. The purpose of the increasing time windows is to maximize time-series site participation in the analysis. While almost all of

the WGZE sites can participate in a 10-year time window comparison, fewer and fewer qualify for the 20- and 30- year comparisons.

The discussions then went into general details regarding the Plankton Status Report topics, “chapters”, and writing assignments. The report will be divided into different ocean regions, as done in the past, but minor changes to the regions were made to better match the regions used in the ICES IROC hydrographic report. As in the previous reports, the CPR will have its own “trans-Atlantic” summary chapter.

#### **Progress in analysing the time-series of Dunkirk West 1978–2017, Elvire Antajan & Eric Goberville**

Dunkirk West station (51°1.33N; 2°9.05E) is located in the western port of Dunkirk, at the lower end of the southern bight of the North Sea. Dunkirk West plankton time-series are part of an ecological survey designed to observe environmental changes on the site of a nuclear power plant. The station is located in the entrance of the channel inflow into the power plant and is not impacted by the power plant water discharge. Change in zooplankton sampling strategy occurred since the beginning of the monitoring. Zooplankton samples were first collected monthly with a standard WP-2 net from 1978 to 1991 and then with a small conical net (opening diameter 34 cm, 113 cm length, 200 µm mesh size) from 1992 to 2007. Since 2008 the sampling is carried out with a standard WP-2 net, bi-monthly from March to September and monthly from October to February. We started statistical analysis for assessing whether changes in sampling devices have influenced (significantly) time-series. Preliminary results on the most abundant species have shown that two major changes were observed since 1978, one in the mid 90’s and the other one around 2010. While the first shift in the time-series may be related to environmental changes (Goberville *et al.* 2014), the second shift seems to coincide with a change in the sampling net. Further investigations are required to confirm this first finding. Another major issue of this work will be to assess potential bias on zooplankton abundance estimation due to net clogging during *Phaeocystis globosa* or *Noctiluca scintillans* blooms.

#### **ToR j) Design and carry out coordinated and collaborative activities with WGIMT and WGPME (including the molecular/taxonomic tasks)**

**Lead: Elaine Fileman, Naiara Rodriguez Ezpeleta; Rapporteur: Arno Pöllumäe**

An overview the ICES Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT) activities over the past year was presented and collaborative links with WGZE and potentially WGPME were highlighted and discussed.

WGIMT membership in 2018 totals 47 members from 17 countries and a number of these members are concurrently members of 9 other ICES SCICOM WGs, including WGZE, WGPME, WGBOSV, WGITMO, WGAGFA, WGCEPH, WGINOR, WGIAB, WGDIG.

To support the collaborative goals and needs of WGZE, WGIMT, and COPEPOD (The Global Plankton Database), Todd O’Brien has created a taxonomic-based information database called “COPEPEDIA” (<http://copepedia.org>). The continuing development and implementation of the WGIMT web platform for promotion and exchange of relevant scientific information was presented and discussed.

WGIMT has continued work to initiate and support provision of standards, training materials, and taxonomy workshops through organized workshops. A number of initiatives

were presented by Maria Grazia Mazzocchi; EUROBUS workshop: Towards an European observatory of the invasive calanoid copepod *Pseudodiaptomus marinus* (Jan 2018); MO-Tax: a SZN Service to promote, maintain and develop taxonomy among marine scientists (EMBRC-IT) and the First Advanced Zooplankton Course: Morphological and Molecular Taxonomy of Marine Copepods (SZN, 22 Oct - 2 Nov 2018).

WGIMT promotes and encourages the use of integrated taxonomic approaches for the assessment of pelagic biodiversity by organizing special sessions at national and international conferences. WGPME shares the focus on analysis of biodiversity using metabarcoding approaches, and this formed the subject of a joint theme session (WGIMT, WGPME, WGZE) for the ICES 2017 ASC (Fort Lauderdale, Florida). Further theme sessions organised include the ASLO/AGU Ocean Sciences Meeting (2018 Portland, Oregon) and the ICES ASC to be held in Hamburg, Sept 2018. WGIMT is seeking avenues via SSGEPD and other SCICOM EGs to advise on implications and applications of integrative taxonomy for marine science and management and will engage in discussion of joint activities on topics of common interest with WGZE/WGPME. WGIMT is jointly involved in WGZE ToR g) to determine the status of microzooplankton time-series data collection within the ICES area. This ToR is also of interest to WGPME. WGIMT members published papers in the peer-reviewed scientific literature on topics central to the WGIMT mission over the past year and a list of these contributions was shown. This led to discussion regarding acknowledgment of WGs in publications. It was recognised that not all of these publications did acknowledge the WG but they were still relevant to the ToR.

#### Discussion:

Todd's comment: WGIMT has published 17 papers, but those papers are not on the webpage yet.

Answer: There is only a list of papers. The list will be added to the webpage and this will be updated every year.

Antoninas question: Does SCICOM count only such papers, where the working group has been referenced in the acknowledgements?

Ann: If a paper contributes to WGIMT ToR, then it will be considered as a working group paper, even if there is no reference.

#### **ToR k) Develop, revise and update of zooplankton species identification keys initially focusing on the most abundant taxa at the ICES time-series sites and ensuring their availability via the web, including especially ICES Zooplankton identification leaflets**

**Lead: Antonina Dos Santos; Rapporteur: Janna Peters**

Leaflets for copepods genera *Oithona* and *Temora* and gelatinous plankton have been planned for the present year. So far a list of leaflets to be revised has been generated, potential authors and reviewers (where already available) were identified and official invitations have been prepared. Three experts for gelatinous plankton have been contacted, one expert from Japan has agreed to contribute but did not provide any manuscript. Maria Grazia Mazzocchi (member of WGZE) offered to provide the revision for *Oithona*.

Some general problems were identified so far. First, it seems difficult to convince experts to commit to this project since their contribution is purely voluntary and may therefore have no high priority for the expert to produce it. Second, since many experts already retired it is very often difficult to identify potential authors and their contacts. Specifically, experts for specific groups are not always available for the ICES area, but they are for other regions in the world.

Claudia Castellani, one of the original key people for this ToR, is no longer available to help with this. The plankton book, edited by her is a valuable basis to proceed in many cases and provides information about potential experts. However, for several taxa (e.g. meroplankton larvae) it only provides keys to group level, while the objective of the leaflets is to provide more detailed taxonomic information enabling the researcher and student to go to lower levels, as genus and species.

The WGZE agrees to proceed with this ToR. Lidia Yebra will support Antonina Dos Santos with this task in the coming year. The WGIMT chair Elaine Fileman suggested it may be possible to recruit a molecular expert from WGIMT to support Antonina Dos Santos with the progression of this ToR. Antonina Dos Santos will send a response on the questions from ICES SCICOM on the status of the leaflets. If ICES support is reconfirmed, she will send out an official invitation to Maria Grazia Mazzocchi together with a template of the leaflets.

The WGZE states that the leaflets are difficult to access at the ICES website, since it strongly depends on finding the right link (which seem to be lost during remodelling of the website) and also on browser type. One quick solution could be to provide at least a list with functioning links to the respecting leaflets. This list could be shared with experts and distributed via various communication channels.