

# ICES WGPME REPORT 2018

ECOSYSTEM PROCESSES AND DYNAMICS STEERING GROUP

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## Report of the Working Group on Phytoplankton and Microbial Ecology (WGPME)

26–29 March 2018

Aberdeen, UK



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## Executive summary

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The 2018 meeting of the Working Group on Phytoplankton and Microbial Ecology (WGPME) was held in Aberdeen, UK, 26–29 March. The goal was to review progress on ongoing projects initiated by WGPME members and to give new and existing members the opportunity to report details of their times-series programmes and results from ongoing local projects. Based on this information a list of new ToRs was discussed.

Following a request from the Science Committee, particular attention was given to the question of whether WGPME was willing to consider genomics more in group's work. As genetic/genomic tools are now in use in some way by WGPME members it was decided that at least one ToR would deal with an ecological food web study that would require the aggregation of a biogeographic data set based on molecular data to investigate smaller food web components. This will also involve a joint sampling campaign and the application of common protocols for molecular analyses. However the group felt that it should not be one group's sole remit to deal with broader issues e.g. concerning methods standardization. WGPME has identified several ICES groups dealing with similar issues (e.g. WGIMT and WGZE) and therefore recommends a joint workshop or conference in which different groups can define their own goals with respect to genomics methods but also find the opportunity to set up and coordinate collaborations with other ICES colleagues.

In addition, WGPME recommends to organise an ICES training course to raise awareness within the ICES community regarding advantages and challenges of different molecular methods.

Another methodological aspect discussed extensively during the meeting was related to the topic of fixation artefacts in water samples that might prevent the consistent identification of different phytoplankton. WGPME is therefore exploring the opportunities for creating an image-based identification resource that will provide high quality images of key phytoplankton species with additionally Lugol-fixed imagery for comparison. This exercise will help to better define the limits of identification for given taxa, helping to achieve better comparability between taxa. The best format for achieving this is still under discussion.

The next steps in ongoing long-term projects in relation data products and dissemination were discussed. The WGPME image library is being extended, plankton status report finalized and the metadata from the WGPME time-series stations linked to a webgis of global time-series stations.

## 1 Administrative details

<b>Working Group name</b>
Working Group on Phytoplankton and Microbial Ecology (WGPME)
<b>Year of Appointment within current cycle</b>
2016
<b>Reporting year within current cycle (1, 2 or 3)</b>
3
<b>Chair(s)</b>
Alexandra Kraberg, Germany
Marie Johansen, Sweden
<b>Meeting venues and dates</b>
5–7 March 2016, Boothbay, USA (12 participants)
28–20 March 2017, Reykjavik, Iceland (12 participants)
26–29 March 2018, Aberdeen, United Kingdom (18 participants)

## 2 Terms of Reference

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Investigate factors affecting the closeness of correlations between chlorophyll <i>a</i> and phytoplankton biomass	a) There is a need to further develop phytoplankton related indicators. The phytoplankton biomass indicators developed so far for the MSFD only consider Chl <i>a</i> as a rough estimate of plankton biomass.	IEOM, objectives 2 and 3	1 year	Position paper with recommendations for the scope of using chlorophyll:biomass (biovolume) correlations in different contexts
b	Review evidence base for the use of simplified indicators for (pelagic) ecosystem change	a) Lack of good phytoplankton descriptors in MFSD	IEOM, objectives 2 and 3	3 years	Review paper, report

c	Joint workshop in 2017 with other ICES WG (climate change, zooplankton, hydrography, harmful algae?)	a) Potentially harmonize methodological approaches (e.g. molecular tools) b) Provide more precise phytoplankton descriptors (MSFD) c) Advice e.g. to OSPAR-COBAM	EPD, objectives 1, 2 and 4 EPI, objective 1	Year 3	Agreed recommendations for methods standardization. Has been postponed to the year 2019.
d	Conduct an integrated analysis of phytoplankton and microbial plankton responses to global warming	a) Understand consequences of long-term changes e.g. in phenology and body size for foodweb functioning and associated ecosystem services	EPD, objectives 1, 2 and 4 EPI, objective 1	3 years	Report
e	Plankton reference database	a) Facilitate better comparability between times-series, producing representative images for all of the species included in each times-series relevant to WGPME	IEOM objective 1	3 years	Completed image database on <a href="http://planktonnet.awi.de">http://planktonnet.awi.de</a>
f	Preparation of peer-reviewed manuscripts	WGPME results need to be made available not only as advice to respective science committees but also to the wider scientific community	All objectives above	3 years	1 manuscript on the robustness of different indicators 1 manuscript on chlorophyll biomass relationships

### 3 Summary of Work plan

The workplan had 3 main components, the continued comparison of methodologies, particularly for next generation sequencing methods and imaging flow cytometry and their integration into routine monitoring programmes. The second deals with comparative analyses of long-term changes in key plankton species in the North Sea and the third component with the visualisation and dissemination of WG results to a wider audience.

### 4 Summary of Achievements of the WG during 3-year term

- The EG have finalized manuscript on molecular methods (a revised version has been submitted to Journal of Plankton Research)

- Several WGPME members have applied for (and were awarded) external funding to carry out an international symposium (Hannover, 11–13 October 2017) to discuss future opportunities for integrating high throughput molecular and imaging flow cytometry-based methodologies for assessing biodiversity into routine plankton times-series operations. Outcomes were:
  - Joint funding proposal to the BIODIVERSA call on scenarios for Arctic ecosystem services. This proposal aims to bring together players in the Arctic working with or holding plankton data combining different technologies e.g. molecular to provide pan-arctic inventory of Arctic plankton diversity
  - A Marie Curie ITN proposal for testing different methodologies in the context of their possible deployment in routine marine monitoring activities. This proposal brought together several WGPME partners and external collaborators which would, if funded also include a course at ICES headquarters. The proposal was not accepted but discussions continue to find an alternative funding source
- Paper on a new protist species and the importance of using image data to document the distribution of unidentified/unnamed species in revision, Molecular methods paper in revision as well (revised version already submitted to journal of plankton research.
- Acquisition of additional data sets. Metadata of WGPME times-series stations are currently being added to a webgis of global times-series stations.

## 5 Final report on ToRs, workplan and Science Implementation Plan

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Most of the ToRs planed have been addressed during the 3-year cycle. Several papers and reports have been the outcome from the work done by members in the group and are either published or in progress to be published. Articles published by individual members but presented for the group and discussed at meetings are:

- Several members have either been co-authors or contributed to the report O'Brien, T. D., Lorenzoni, L., Isensee, K., and Valdés, L. (Eds). 2017. What are Marine Ecological Times-series telling us about the ocean? A status report. IOC-UNESCO, IOC Technical Series, No. 129: 297 pp. for more details of the contact of the report please visit: <https://igmets.net/report>
- J S. Lan Smith, Sergio M. Vallina & Agostino Merico (2016) Phytoplankton size-diversity mediates an emergent trade-off in ecosystem functioning for rare versus frequent disturbances Scientific Reports, volume 6, Article number: 34170. Aim of the article: To use a continuous trait-distribution model for a phytoplankton community of gleaners (those species that do well when nutrients are scarce) competing with opportunists (species that do well when nutrients are plentiful). Then we subjected the model community to differing frequencies of disturbance, in order to examine diversity-productivity relationships at different time-scales.
- S .M. Vallina. P. Cermenon, S. Dutkiewicz, M. Loreau & J. M. Montoya (2017) Phytoplankton functional diversity increases ecosystem productivity and sta-

bility Ecological Modelling, Volume 361, Pages 184-196. Aim of the article: the use of an ecosystem process model to explore the potential effects of biodiversity on ecosystem functioning for marine phytoplankton. Multiple phytoplankton species, representing differing degrees of functional diversity, are defined by their species-traits with respect to two environmental niche gradients: nutrient concentration and ocean temperature.

- Wasmund, N., Kownacka, J., Göbel, J., Jaanus, A., Johansen, M., Jurgensone, I., Lehtinen, S., Powilleit, M. (2017): The diatom/dinoflagellate index as an indicator of ecosystem changes in the Baltic Sea. 1. Principle and handling instruction. *Frontiers in Marine Science* 4 (22): 1-13. doi: 10.3389/fmars.2017.00022  
Aim and principal results: Development of the Dia/Dino-Index for implementation of the Marine strategy Framework Directive. This indicator was tested by HELCOM for the Eastern Gotland Basin in the "State of the Baltic Sea - Second HELCOM holistic assessment 2011-2016." *Baltic Sea Environment Proceedings* 155.

**ToR a)** Investigate factors affecting the closeness of correlations between chlorophyll *a* and phytoplankton biomass:

To be continued in next 3-year cycle.

**ToR b)** Review evidence base for the use of simplified indicators for (pelagic) ecosystem change. See also paper published on ratio between dinoflagellates and diatoms above.

Paper in production on changes in key species in preparation. The paper includes selected and robust species that are commonly found in the area and thereby have an important part of the community. The species selected are easily recognized to the chosen taxonomic unit and thereby make the dataset and analyses robust and not dependent on the taxonomist. Trends in occurrence are compared to environmental parameters to discover changes in the plankton community due to environmental changes.

**ToR c)** Joint workshop in 2017 with other ICES WG (climate change, zooplankton, hydrography, harmful algae). Postponed to 2019 where a joint meeting with WGZE will be organised at the Canaries Islands in March. At the joint meeting the monitoring of microzooplankton will be discussed as this group lack regular sampling in many countries. The microzooplankton is important in the food web but are not properly sampled in either zooplankton or phytoplankton monitoring. The meeting will also discuss and resolve how the integrated plankton report, integrating zooplankton and phytoplankton, should be developed and finalized.

**ToR d)** Conduct an integrated analysis of phytoplankton and microbial plankton responses to global warming. Partly covered in the report series produced by the group. Data have also been collected for the ToR that will produce another report within the report series.

**ToR e)** Plankton reference database ongoing work and the database at <http://planktonnet.awi.de> is used for this purpose.

**ToR f)** Preparation of peer-reviewed manuscripts ongoing work. Two manuscripts have been submitted:



- 1) Stern *et al.* Molecular analyses in protist long-term observation programs- current status and future perspectives. Submitted to Journal of Plankton Research (2. Revision just submitted).
- 2) Kraberg *et al.* First records of a potentially new autotrophic species in the North Sea: The importance of image-referenced data, Submitted to Marine Biodiversity Records (1. Revision now in progress).

## 6 Cooperation

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### Cooperation with other WG

- Marine Chemistry: The marine chemistry group is updating an outdated TIMES report on Chlorophyll determination. This is activity lead by Marine Chemistry but WGPME is providing biological input as needed and following the annual WGPME meeting in 2018 it was agreed that PME members would comment on the existing draft.
- A joint session with WGIMT was held at the ICES Annual Science conference in Fort Lauderdale 2017. The name of the session was Microbes to mammals: metabarcoding of the marine pelagic assemblage. The theme session outcome was to integrate and discuss. The WGPME group has the suggestion that ICES should organize a workshop in which different groups can define their own goals with respect to genomics methods but also find the opportunity to set up and co-ordinate collaborations with other ICES colleagues.

### Cooperation with Advisory structures

It was agreed in the context of the above mentioned ITN proposal to organize a course at ICES Headquarters in Copenhagen in which a session with ACOM has been proposed to introduce participants of the workshop to the decision making and advice processes in ICES. The ITN has several purposes where one possibility is to train the next generation of **scientists in transferable** along with **core scientific** skills but also in the necessary tools to develop new projects and technologies and integrate them with ongoing times-series. This cohort of inquisitive scientists trained in all these disciplines, will have the **multidisciplinary and collaborative skills** to use the novel technologies to tackle new research fields (e.g. species interactions phytoplankton dynamics at high spatial and temporal resolution, the characterization of entire phytoplankton communities based on single cell analysis or phylogenetic diversity of both microbial autotrophs and heterotrophs and their parasites).

## 7 Summary of Working Group self-evaluation and conclusions

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A copy of the full Working Group self-evaluation is given in Annex 4.

## Annex 1: List of participants

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## Annex 2: Recommendations

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RECOMMENDATION	ADDRESSED TO
Establishment of an online reference repository for Lugol-fixed plankton imagery. Advice is sought on how best to implement this in order to make it available to the ICES community and other stakeholders.	DIG, ICES Secretariat

### Annex 3: WGPME draft resolution 2019–2021

The **Working Group on phytoplankton and microbial ecology** (WGPME), chaired by Marie Johansen, Sweden and Rowena Stern, UK, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2019	11–14 March	Las Palmas de Gran Canaria, Spain	Interim report by 1 May	
Year 2020			Interim report by Date	
Year 2021			Final report by Date	

#### ToR descriptors

	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
ToR					
a	Generate oimproved knowledge of small food web components that are poorly monitored/assessed	There is a lack of consideration of microbial biomass in monitoring and assessment studies.	Understanding ecosystems (Code 2)	3 Years	Review paper (in year 3) Feed into relevant national and international working groups as appropriate
b	Participate on a joint one day back to back workshop in 2019 with WGZE.	a) Potentially harmonize methodological approaches (e.g. molecular tools) b) Provide more precise phytoplankton descriptors (MSFD) c) Advice e.g. to OSPAR-COBAM	Understanding ecosystems (Code 2); Observation and exploration (Code 4) Emerging techniques and technologies (Code 5)	Year 1	Agreed recommendations for methods stand-ardization and indicator sets
c	Conduct an integrated analysis of phytoplankton and microbial plankton re-	Understand consequences of long-term changes e.g. in phenology and body size for foodweb functioning and associated	Observation and exploration (Code 4)	3 years	Papers production depending on the key outcomes.

	sponses to global warming.	eco-system services.			
d	Produce a guide of live vs Lugol-fixed key species from exisiting samples.	Facilitate better comparability between times-series, producing representative images for to facilitate better comparability between times-series, producing representative images for all of the species included in each times-series relevant to WGPME, provide realistic images pointing out limits of species IDs.	Conservation and management (Code 6)	3 years	Recommendation document to ICES to set up a database and ICES identification leaflets.
e	Produce a Cooperative Status Report.	To develop an integrated plankton report presenting trends in occurrence of both phyto and zooplankton	Observation and exploration (Code 4)	Year 2	Report
f	Investigate factors affecting the closeness of correlations between chlorophyll a and phytoplankton biomass.	There is a need to further develop phytoplankton related indicators. The phytoplankton biomass indicators developed so far for the MSFD only consider Chl a as a rough estimate of plankton biomass.	Understanding ecosystems (Code 2); Impacts of human activities (Code 3)	Year 3	Position paper with recommendations for the scope of using chlorophyll:biomass (biovolume) correlations in different contexts

### Summary of the Work Plan

Year 1	A joint workshop with WGIMT, WGZE with the goal of further methods standardization. This is of high priority, to finalize the plankton status report. Most of the ToR will run for the whole 3 years period.
Year 2	Assemble data for (online), to continue work on manuscripts already in preparation. Finilize the integrated plankton report.
Year 3	Discuss assesment efforts historically made of the small food web components. The generation of recommendations to improve how they best can be concidered and applied in food web assessments.

### Supporting information

Priority	The current activities of this Group will lead ICES into issues related to the ecosystem effects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
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Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible. However the resource of a database with identification leaflets of phytoplankton would be recommended.
Participants	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities	Standard secretarial support
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There is a close working relationship with WGZE, WGIMT and also some linkage to WGHABD.
Linkages to other organizations	None specific

## Annex 4: WGPME self-evaluation

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- 3) **Working Group name:** Working Group on Phytoplankton and Microbial Ecology (WGPME)
- 4) **Year of appointment:** 2016
- 5) **Current Chairs:** Alexandra Kraberg, Marie Johansen
- 6) Venues, dates and number of participants per meeting:
  - 5–7 March 2016, Boothbay, USA, (12 participants)
  - 28–20 March 2017, Reikjavik, Iceland, (12 participants)
  - 26–29 March 2018, Aberdeen, United Kingdom, (18 participants)

### WG Evaluation

- 7) If applicable, please indicate the research priorities (and sub priorities) of the Science Plan to which the WG make a significant contribution.
  - Evaluation of phytoplankton assessment methodologies, including molecular methods
  - Long-term changes in key species across large biogeographic areas
- 8) In bullet form, list the main outcomes and achievements of the WG since their last evaluation. Outcomes including publications, advisory products, modelling outputs, methodological developments, etc. \*
  - Methodological manuscript (now in revision) reviewing and discussing current molecular tools in phytoplankton research and their future challenges
  - Manuscript (in revision) on the distribution of an unknown phytoplankton species with a discussion of the value of combining imaging and numerical data
  - Advice to OSPAR on new edition of eutrophication guidelines
  - Image gallery with representative phytoplankton images of species worked on by the group.
- 9) Has the WG contributed to Advisory needs? If so, please list when, to whom, and what was the essence of the advice.:
  - see point 6.3
- 10) Please list any specific outreach activities of the WG outside the ICES network (unless listed in question 6). For example, EC projects directly emanating from the WG discussions, representation of the WG in meetings of outside organizations, contributions to other agencies' activities.
  - Joint application of several group members for EU funding ( re-submission currently in preparaton)
- 11) Please indicate what difficulties, if any, have been encountered in achieving the workplan.
  - The only problems and difficulty relate to the time needed to acquire, process and analyse data, which means that we cannot work on



some projects continuously, but this is not a WGPME-specific problem

### **Future plans**

12 ) Does the group think that a continuation of the WG beyond its current term is required? (If yes, please list the reasons) YES

- Projects such as methods standardization are clearly long-term activities
- With the enormous plankton data set now assembled we are now able to carry out complex analyses over large scales also interacting with groups such as WGZE to extend our work more to the entire plankton foodweb

13 ) If you are not requesting an extension, does the group consider that a new WG is required to further develop the science previously addressed by the existing WG. NO as we would like to request an extension to continue our work.

14 ) What additional expertise would improve the ability of the new (or in case of renewal, existing) WG to fulfil its ToR?

- Advanced statistical and ecosystem/hydrographical modelling. A new member with experience in ecological modelling and traits analyses has already joined the group.

15 ) Which conclusions/or knowledge acquired of the WG do you think should be used in the Advisory process, if not already used?

- Improved knowledge on methodological approaches, including future challenges, for long-term monitoring.