

ICES WGPME REPORT 2016

SCICOM STEERING GROUP ON ECOSYSTEM PROCESSES AND DYNAMICS

ICES CM 2016/SSGEPD:06

REF. SCICOM

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

5–7 April 2015

East Boothbay, USA



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Recommended format for purposes of citation:

ICES. 2016. Interim Report of the Working Group on Phytoplankton and Microbial Ecology (WGPME), 5–7 April 2015, East Boothbay, USA. ICES CM 2016/SSGEPD:06. 11 pp. <https://doi.org/10.17895/ices.pub.8428>

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Executive summary

The 2016 meeting of the Working Group on Phytoplankton and Microbial Ecology was held at Bigelow Laboratory for Ocean Sciences, East Boothbay, USA, 5–7 April 2016. As it was the first meeting for the current cycle of ToRs discussions were to a large extent devoted to the organization of future work for each topic.

Several new/prospective members (from the United States, Canada and Iceland) attended the workshop and gave presentations of their work including descriptions of the data that can be contributed to the group. These included a review on available chlorophyll and species data from Iceland and a detailed introduction to the Martha's Vineyard observatory including the Imaging Flow Cytobot.

These presentations led to a detailed discussion of emerging time series based on imaging flow cytometry techniques and their potential for routine long-term observations. The need for better co-ordination in this field of 'high throughput monitoring' was emphasized by the group members and it was agreed to organize a larger workshop/symposium to bring together key members of this still very new community to discuss the potential for harmonization of methodologies to enhance comparability of data sets in future.

WGPME will continue to follow this dual approach of data collection and integration followed by detailed data analyses on one hand and reviews of methodologies used to generate such data sets.

1 Administrative details

Working Group name

Working Group on Phytoplankton and Microbial Ecology (WGPME)

Year of Appointment within current cycle

2016

Reporting year within current cycle (1, 2 or 3)

1

Chair(s)

Alexandra Kraberg, Germany

Marie Johansen, Sweden

Meeting venue

East Boothbay, USA

Meeting dates

5–7 April 2016

2 Terms of Reference a) – z)

ToR	DESCRIPTION	BACKGROUND	SCIENCE PLAN		EXPECTED DELIVERABLES
			TOPICS ADDRESSED	DURATION	
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
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 time series, producing representative images for all of the species included in each time series relevant to WGPME	IEOM objective 1	3 years	Completed image database on http://planktonnet.awi.de
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

Year 1	Based on the data already collected the analysis of species-specific long-term trends in phytoplankton will be continued, establish a work programme on tests of the suitability/robustness of different phytoplankton indicators, particularly those in use for the EU MSFD will be established. Exploration of closer collaboration with WGIMT.
Year 2	Provide a new co-operative research report, finish the image database providing images of all taxa routinely reported for the time series stations represented by the group.
Year 3	Carry out a joint work shop with working groups such as WGHABD, continue work on long-term dynamics of phytoplankton at large spatial scales.

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

- Review of molecular and non-molecular techniques: in addition to a general questionnaire in 2013 a questionnaire has also been produced for molecular techniques. The results have been discussed and analysed during the annual meeting in Plymouth. Progress was summarized in the Bigelow Laboratory meeting. The manuscript has now been completed and has been submitted in May.
- The ICES online image library has been expanded. During the meeting we discussed mechanisms for incorporating further reference collections, e.g. as metadata for sensor-based monitoring systems such as the Imaging Flow Cytobot and FlowCAM or for biodiversity investigations using molecular tools (this is also relevant to ICES' data systems).
- The content of the 2nd WGPME status report has been finalized.
- WGPME chair participated in ICES advice drafting group reviewing the JAMP phytoplankton monitoring guidelines, Copenhagen, June 2016.
- WGPME in collaboration with WGHABD submitted a proposal for a theme session on phytoplankton time series for the ICES ASC 2016 which was successful.

5 Progress report on ToRs and workplan

As WGPME has just started a new set of ToRs, discussions during the workshop focussed mainly on how to implement these. A topic that has been important throughout WGPME's life-time is the analysis of methodological approaches to monitoring/analysing phytoplankton and microbial communities. A review of conventional and molecular techniques has been completed. The latter will be submitted to the ICES Journal of Marine Science. Methodological approaches will remain a major focus in the new ToR cycle as well. To foster achievement of the goals of the new ToR cycle, several guests were invited and gave short presentations of their activities. These included:

Heidi Sosik (Martha's Vineyard Cabled Observatory). This Observatory runs a number of autonomous sensor systems for observations with a high temporal resolution. These include an Imaging Flow CytoBot. The measured parameters, challenges and applications particularly of the Imaging Flow Cytobot were described.

Nick Record, from the Bigelow Laboratory reported on trait-based analyses of phytoplankton communities using a Gene-organism-population-community approach. The idea of traits originates from terrestrial science. The main conclusion presented was that the most important trait appears to be size.

Hafsteinn Gudfinnsson, from the Marine Research Institute, Iceland gave a brief report on the time series data available from Iceland which included chlorophyll and also phytoplankton data.

The following items have been or will be addressed:

ToR A: Biomass/biovolume/chlorophyll relationships

Issues related to the measurement of biovolume and chlorophyll, as well as the relationships between them were discussed at the meeting at Bigelow Laboratory, as they are important in the context of assessment of good environmental status as required by, for example the European Union Marine Strategy Framework Directive (MSFD). Different methods are used for chlorophyll, namely HPLC and fluorometric methods. While the former provides very detailed results, the latter is quicker and less costly. Both methods were shown to present different results. Different group members reported their experience with productivity measurements. Problems that have been reported are a lack of comparability of different methods which is a requirement of the MSFD. This issue is also being discussed by the WG Marine Chemistry.

ToR B: The use of simplified indicators

A range of indicators for long-term changes in marine systems, including phytoplankton communities are in use. With many of these their robustness and potential breadth of application have not been shown. To what extent this can be addressed using WGPME data was discussed. Most indicators do not seem to aim to address change in response to particular drivers but instead concentrate on detecting change/shifts themselves in communities, revealing potential environmental impacts over time using standardized methodologies. One such index – the plankton life form index proposed for use in the Marine Strategy Framework Directive was presented during the workshop by Eileen Bresnan.

ToR C: Joint workshop with other ICES groups

Prior to the meeting at Bigelow Laboratory, a joint session at an upcoming ICES session with WGIMT had already been agreed with a view to exploring the potential for harmonizing methodological approaches used in molecular monitoring of phytoplankton. An abstract is being prepared by all relevant parties. A joint meeting with this group as well as with WGZE and possibly WGHABD has been discussed, possibly for 2018.

ToR D: Responses of phytoplankton and microbial plankton to global warming

One of the main outputs from this ToR will be an update to the WGPME-created ICES Phytoplankton & Microbial Plankton Status Report, which will be published as an ICES Cooperative Research Report (CRR). Additional efforts supporting this ToR are also featured in ToR F, in a peer reviewed format.

During the Bigelow meeting, a brief update was given on the progress of the global IOC-UNESCO International Group for Marine Ecological Time Series (IGMETS, <http://igmnets.net>). WGPME-associates currently represent over 100 of the (North Atlantic) time series participating in IGMETS. Through joint group member Todd O'Brien, the efforts of these two time series working groups are being carefully coordinated to complement (and not compete or duplicate) with each other. Some of the newly developed IGMETS analyses and tools (e.g., spatio-temporal trend fields, the interactive time series explorer interface) will be updated and modified for use by WGPME in its upcoming status report and in its <http://WGPME.net> web pages.

Discussions and planning were done for WGPME's next status report. A data call was sent out before the Bigelow meeting, with responses from many of the report contributors and participants. A deadline of "end of May" was set for the remaining members to send in data updates. Once all data are received, standard analysis and figures can be created and returned to the participants for writing their individual site summaries as well as the cooperative regional overviews and the trans-Atlantic study sections.

The next status report will keep most of the same format as the first report (e.g., introduction, methods, sections for eight major North Atlantic sub-regions, ending with a trans-Atlantic overview and analysis). It was proposed to also add special topic "two-page" briefings to the report, covering the topics listed shortly below. These topics were selected to highlight ongoing work within WGPME, providing the reader with a quick introduction to the topic as well as a WGPME contact point for ongoing work in that area. In this way, it is hoped to bring in new WGPME members with interests in genetic/molecular or optical taxonomy, for example:

- **An Introduction to "Phytoplankton":** A brief overview of the major groups and players within the microbial plankton, phytoplankton, and microzooplankton.
- **Abundance vs. Biomass vs. Carbon Content:** A brief overview of how they are measured and what each type can or can't tell us about the plankton community.
- **Molecular Taxonomy:** A brief overview of how "genetics" can be used to distinguish or enhance traditional morphological taxonomy
- **Optical Taxonomy:** A brief overview of image-based automatic identification systems.

ToR E: Integrated Image reference library

This has already been set up in 2014, but was taken up as a ToR in its own right to account for new developments such as automated imaging systems and their needs for the archival of data and metadata and the establishment of reference collections of manually annotated images which serve as a basis for automatic identification.

During the meeting the options for linking data from the Imaging Flow Cytobot (IFCB) to the existing WGPME image collection and establishment of a separate image reference collection were explored. The archival, visualisation and analysis of high throughput monitoring devices such as flow cytometry-based devices or molecular sensors were identified as a key issue to be addressed in the future. The group recommends that ICES, in the context of its own data systems, pays attention to this issue. WGPME will also apply for external funding for a larger workshop or symposium to bring together experts in the field to discuss technical issues such as standardization of methodologies and protocols as well as setting up more efficient communication channels in a community that is at present still small and relatively fragmented.

ToR F: Preparation of peer-reviewed manuscripts

One manuscript has been completed (molecular methods review) while others are ongoing. Their lengthy production times are mainly due to difficulties procuring data for certain areas and also result from the time-consuming data integration steps required for the

analyses. During the Bigelow Laboratory meeting further potential data providers were discussed (for instance it was unclear who is responsible for some of the Norwegian phytoplankton data sets. The respective persons were contacted following the Bigelow Laboratory meeting to discuss potential contributions.

For the planned manuscript on *Synechococcus* it was discussed whether the scope might be extended of the manuscript should be extended to further types of bacteria. As the planned first author of this manuscript could not attend the meeting, a decision on this question was deferred to a later time. Glen Tarran agreed to contact Xelu Moran for further discussions on the issue.

6 Revisions to the work plan and justification

None.

7 Next meetings

WGPME 2017 meeting will take place in Reykjavik, Iceland, 28–30 March.

Annex 1: List of participants

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Annex 2: Recommendations

RECOMMENDATION	ADDRESSED TO
1. Joint workshop with WGZE and WGIMT to review methodologies for taxonomic identification and monitoring including high throughput molecular methods.	WGZE, WGIMT, SSGEPD
2. Organization of an external workshop coordinated by WGPME with the aim to investigate the implications of high throughput molecular and image-based monitoring techniques for time series management and the analysis of time series data.	WGPME, SSGEPD
3. Greater consideration given to images within ICES's, especially in the context of ICES's own data systems. These data systems should include workflows for integrating image metadata from biological time series including information obtained on flow cytometry and imaging cytometry based systems.	SCICOM