WORKING GROUP ON PHYTOPLANKTON AND MICROBIAL ECOLOGY (WGPME; OUTPUTS FROM 2024 MEETING)

VOLUME 7 | ISSUE 6

ICES SCIENTIFIC REPORTS

RAPPORTS SCIENTIFIQUES DU CIEM

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CIEM CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

ISSN number: 2618-1371

ICES Scientific Reports

Volume 7 | Issue 6

WORKING GROUP ON PHYTOPLANKTON AND MICROBIAL ECOLOGY (WGPME; OUTPUTS FROM 2024 MEETING)

Recommended format for purpose of citation:

ICES. 2025. Working Group on Phytoplankton and Microbial Ecology (WGPME; Outputs from 2024 Meeting).
ICES Scientific Reports. 7:6. 40 pp. https://doi.org/10.17895/ices.pub.28239779

Editors

Rowena Stern-Kluckner • Nicole Poulton

Authors

Laura Alonso-S Sáez • Felipe Artigas • Eileen Bresnan • Catarina Churro • Marina Chifflet • Dave Clarke • Veronique Creach • Emmanuel Devred • Pablo Ignacio León Diaz • Martin Edwards • Isabel Ferrera • Gayantonia Franzè • Bárbara Frazão • Siv Huseby • Hans Jakobsen • Marie Johansen • Iveta Jurgensone • Laura Käse • Inga Kirsten • Alexandra Kraberg • Anders Lanzén • Sirpa Lehtinen • Sarah Lerch • Christian Lønborg • Arnaud Louchart • Emilio Marañón • Katja Metfies • Malin Mohlin • Xosé Anxelu Morán • Glaucia Moreira Fragoso • Todd D. O'Brien • Renata Pilkaitytė • Nicole Poulton • Nicholas Record • Ian Salter • Robyn Samuel • Felix Sproll • Heidi Sosik • Dominique Soudant • Rafael Gallardo Salas • Rowena Stern-Kluckner • Glen Tarran • Eva Teira • Anneke van den Oever • Marta Varela • Diana Vaičiūtė • Claire Widdicombe

ICES CIEM International Council for the Exploration of the Sea Conseil International pour l'Exploration de la Mer

Contents

i Executive summary

The ICES Working Group on Phytoplankton and Microbial Ecology (WGPME) provides tools and expert perspectives on ecology, taxonomy, and methodological analysis of phytoplankton and other planktonic microbes that contribute to ecosystem services such as oxygen production and nutrient cycling. The working group has 45 members as of 2024, seven of which are new to WGPME with attendees. The groups ToRs reflect the needs of the scientific community related to marine management: access to data and easily accessible figures from long-term datasets and to develop ecological interpretations of changing phytoplankton seascape. The group produced 93 publications between 2021–2024 including key tools, a Metabase report and online data visualization tool on long-term phytoplankton trends and cross-disciplinary outputs.

Long-term ecology: The cooperative zooplankton and phytoplankton report (ToR D) has compiled data from all ICES coastal and open water ecoregions and additional Western Atlantic stations and near completion by January 2025. Major phytoplankton shifts are observed. ToR C long-term phytoplankton influences aim to generate a manuscript on cyanobacterial trends from multiple stations because models and hindcast publications predict an increasing dominance of smaller phytoplankton in several North Atlantic regions. This will influence marine foodwebs.

Tools: ToR E Metazoogene DNA-based species mapping tool has added more than 84 000 phytoplankton and microbe species (https://metazoogene.org/atlas) with increasing trends in using genetic analysis alongside microscopy, this will allow non experts to visualize genetically identified species alongside other datasets. Metazoogene is a cooperative effort with WGIMT and WGZE. This challenging task will mean this ToR will continue to curate and improve visualization tools. ToR F aims to report on rare taxa that are non-native or rarely recurring with 18 new observations. New phytoplankton, including harmful algae, have been reported and new mapping tools have been developed and visualized from OBIS to assess spatio-temporal trends from the origin of first sighting.

Information and management: In ToR A, we are gathering information on nano and picoplankton (small phytoplankton less than 10 and 2µm respectively) to incorporate into global datasets. Data from 17 stations from nine countries will be incorporated into Metabase database with increasing monitoring and regulation of smaller phytoplankton. ToR B has assisted members in methods or tools for members to developing indicators for their region or country. This term members delivered nine phytoplankton and ecosystem assessment reports at national and regional levels for OSPAR and HELCOM and seven publications WGPME developing indicators, with increasing use of high-throughput observations.

Collaboration and communication: WGPME chair R. Stern co convened thematic session F at ICES ASC 2023 with WGHABD (D. Clarke) and WGIMO (C. McKenzie) with 134 hybrid attendees and 26 presentations where we delivered recommendations for integrating genetics into marine management. In 2024, we have been introduced to IOC group TrendsPO with members collaborating on similar objectives.

ii Expert group information

Expert group name	Working Group on Phytoplankton and Microbial Ecology (WGPME)
Expert group cycle	Multi-annual
Year cycle started	2022
Reporting year in cycle	3/3
Chairs	Rowena Stern, UK
	Nicole Poulton, US
Meeting venues and dates	13-15 June 2022, online
	November 2022, online
	20-23 March 2023, ICES HQ, Copenhagen, in-person and online (hybrid)
	November 2023, online
	13-15 May 2024, ICES HQ, Copenhagen, in-person and online (hybrid)

1 Generate improved knowledge of small foodweb components that are poorly monitored/assessed (ToR A)

Small phytoplankton, known as picoplankton and nanoplankton, are collective taxonomically diverse set of plankton under 20 microns in size that cannot be identified well by microscopy. The phytoplankton component under 20 microns are the main contributors to phytoplankton biomass and up to 50% of the diversity of Atlantic waters influenced by their water masses and seasonality (Bolanos *et al.*, 2020). Cyanobacteria *Prochlorococcus* and *Synechococcus* are estimated to represent around 15% marine bacterial biomass, *Prochlorococcus* estimated to produce up to half net primary production in oligotrophic waters (Bar-On *et al.*, 2019, Bagby and Chisholm, 2015, Vaulot *et al.*, 2015). WGPME and WGZE members published a paper in English Channel calculated them the smallest planktonic organisms to comprise 71% of the biomass over 14-year period (McQuatters-Gollop *et al*., 2024). They serve a diverse role in primary production to nutrient recycling and make up the majority of diversity and abundance in the oceans (de Vargas *et al.* 2015). Many of these are measured through automated optical methods such as flow cytometry and imaging methods, with several continuously been monitored for more than 10 years, making their datasets useful for research and marine management. The group agreed that knowledge of data sources for smallest phytoplankton and bacterioplankton and their spatio-temporal patterns would be useful but are difficult to find and often overlooked. Since 2021, a questionnaire on monitoring activities and datasets for these smallest plankton sets were completed by WGPME members representing nine countries, one Atlantic wide survey 17 stations or transects in the Baltic, Greater North Sea, and Celtic seas ICES ecoregions.

Several members have active research projects generating data and modelled products related to this ToR see Annex 3 and below.

Outcomes

- A questionnaire led by I. Salter has been completed by members and will be incorporated into the WGPME website and METABASE as a tool to be used by stakeholders to identify where smaller plankton are measured regularly. This activity is now complete.
- Two-thirds of participants surveyed total chlorophyll and microplankton for phytoplankton biomass and phytoplankton community composition spanning 3 to > 40 years. A third of respondents used flow cytometry. All of these were for sustained observations.
- The questionnaire identified omics techniques used by half of respondents and imaging techniques by a quarter for less than five years. Almost all of these were used for research purposes only, as genetic data are not required for most national monitoring agencies.
- 29 WGPME member publications used flow cytometry or genetic methods to investigate pico- or nanoplankton from Baltic to tropical ecosystems. Many focused on size-based functional traits to describe ecological trends in high impact publications e.g. Marañón *et al*., 2024, Heneghan *et al*., 2024, and Sosik *et al*., 2024.
- Key data synthesis paper published by WGPME members:
  - Description of long-term pico- and nanoplankton observations in the Celtic Seas integrated these datasets alongside the whole plankton spectrum and abiotic variables (McEvoy *et al*., 2023).
  - Recommendations for the standardization of pico- and nanoplankton groups measured by flow cytometry to assist in global data analysis efforts of the smallest phytoplankton (Thyssen *et al*., 2022, Boss *et al*., 2022).

  - First combined database and report of DNA metabarcoding and current and historic microscopic observations for the Faroese waters to include smaller phytoplankton (Salter and Mortensen, 2024).

Many members are now regularly using and developing automated optical methods alongside machine learning algorithms to measure small plankton.

- The increasing use of automated methods to measure the smallest plankton are likely to increase and knowledge gaps in the community on their uses and limitations.

2 Update on Explore the use of indicators and provide recommendations for methods (ToR B)

Much of the work of WGPME members feeds into marine regulatory frameworks such as the EU Marine Strategy Framework Directive (MSFD), the UK Marine Strategy (UK seas), the Helsinki Commission (HELCOM, Baltic Sea), and OSPAR convention (NE Atlantic) assessments, see Annex 3. Central to all of these is the application of an ecosystem approach to manage human activities by assessing a set of descriptors of marine health. This assessment is used to manage member states' compliance with legislation to maintain healthy seas and quantify affects of sustainability policies. Such descriptors include the maintenance of biodiversity for functional stability, foodwebs for sustainability or eutrophication states (linked to unbalanced nutrients) according to a set of criteria. Each country interprets or manages assessments in their own way. Much of this work of WGPME members analyse long-term monitoring data trends to develop phytoplankton or microbial indicators that meet these criteria to measure healthy seas at the base of the foodweb. Indicators are a method applied to a set of variables that meet certain criteria in measuring the status of a descriptor. A key feature is that the indicator must relate to human activities such as climate change or nutrient input. All this work depends on long-term plankton data. Existing examples are Diatom to dinoflagellate ratios that indicate how well nutrients are converted to biomass (Bedford *et al*., 2020). Chlorophyll is used to report on phytoplankton biomass levels and can also indicate eutrophication states.

The ICES WGPME is an important opportunity to exchange ideas on indicator methodology, outcomes of indicator assessments and new monitoring tools. In this period, WGPME members participated in nine assessments for OSPAR and HELCOM regions using existing tools. The team shared methodological approaches with six papers translating science into management outcomes, such as indicator of functional trait development. Some members are focused on the smallest-sized plankton, which are the hidden majority at the base of the foodweb and responsible for nutrient cycling. These can be accurately quantified by flow cytometry but only into large aggregate groups. Presentations of time-scale coherence methods in the English Channel demonstrated how flow cytometry measured groups can be linked to human-influenced "pressures" like SST or nutrient levels (McQuatters-Gollop *et al*., 2024). Essential how their phenologies are linked to abiotic variables or to other plankton forms. However, the smallest plankton have different dynamics to larger phytoplankton with short scale growth responses to nutrients. This makes it challenging to measure them in the same scales as larger microphytoplankton.

Outcomes:

- Ten members have 15 publications relating to this ToR, seven of which directly reporting on official plankton indicators, developing indicators or management tools for phytoplankton, see Annex 3.
- Key highlights from OSPAR and HELCOM assessments are:
  - Jacobsen *et al*., 2023 review of cyanobacterial biomass for HELCOM Baltic Sea assessment 1990-2020 revealed significant spatial variation and recommended splitting regional assessments as a result. There were significant seasonal trends and North–south split in species distribution of *Aphanizomenon* and *Nodularia* cyanobacteria respectively, likely reflecting salinity trends.

- A. Louchard, F. Artigas, E. Bresnan have contributed to four OSPAR reports on phytoplankton biomass, primary production, diversity and community changes in 2022-2023 (Annex 3). These show overall declines in dinoflagellate and diatom phytoplankton in NE Atlantic from 1969-2019 linked to environmental pressures such as precipitation and windspeed. 70% of data showed atypical total plankton community composition trends between 2015-2019 linked to climatic indices, nutrients and pH in different NE Atlantic regions compared to pre-2015 states.
- R. Stern, G. Tarran, C. Widdicombe, E. Bresnan contributed to indicator development work for the smallest phytoplankton under 20 microns in size (McQuatters-Gollop *et al*., 2023) demonstrating sub-annual links to human-linked environmental pressures
- Three publications Jerney *et al.*, 2022 Recio *et al.*, 2024 and Lehtinen *et al*., 2021 demonstrate conversion of taxonomic to functional classifications, which can facilitate indicator development. Two of these papers use high-throughput genetic and flow cytometry sorted data demonstrating broadening datasets that can capture smaller phytoplankton and better integrate biochemical functionality in measuring ocean health.

- With increasing use of alternative monitoring methods and maintaining associated data standards required for accurate long-term assessments, the group will decide on adding a sub-ToR on new approaches to indicator development.

3 Conduct an integrated analysis of phytoplankton and microbial plankton responses to global warming (ToR C)

This ToR represents the central aim of WGPME group. Currently, the group has decided to focus their analysis on the cyanobacterial phytoplankton, *Synechococcus*. This cyanobacteria dominates temperate seas. This genus has multiple ecotypes/clades and has been shown to dominate part of the English Channel (ICES regions Celtic and North Sea) in summer (Schmidt *et al.*, 2020) and may be increasing in central Atlantic systems as detailed in the Metabase report for 2012–2022. Long-term data from Western and Eastern Atlantic stations has been compiled and analysed by Heidi Sosik and N. Poulton. A WGPME subgroup has been established during 2024 and will be to meet in spring 2025 to begin manuscript preparation.

Outcomes

- Data from 31 sites were compiled showing trends of *Synechococcus* within the ICES ecoregions and Western Atlantic.
- Publications: Members produced 51 publications, representing the largest activity in this group.
- Highlights from ToR C publications (see Annex 3) are:
  - **Cyanobacteria**: Trait responses of cyanobacteria to sea surface warming from 22 North Atlantic research cruises that demonstrate taxa, season and distance from shore influence growth patterns (Stevens *et al.*, 2024) while temperature and nutrients changed the cell size of cyanobacteria (Maranon *et al.*, 2024), which differ from picoeukaryotes, confirm patterns observed in summer in the Western English Channel of Celtic Seas region (Schmidt *et al*., 2020). In the Bay of Biscay, changes in mean cell size, cell volume, and carbon emerged in picophytoplankton linked to thermal stratification and lower nutrient availability. Increasing temperature and stratification periods in this region will shift phytoplankton communities towards picoplankton size classes (De la Iglesia-Velez *et al.*, 2024).
  - **Heterotrophic bacteria**: Temperature relationships with heterotrophic bacteria were found by Moran *et al*. (2020). Cell size varies inversely related to temperature in the Red Sea (but not consistent in other tropical areas). Temperature consistently enhanced Dissolved Organic Matter consumption by heterotrophic bacteria. Heterotrophic bacterial biomass varies by threefold by area in global oceans, but metabolic activity increases by an order of magnitude from polar to tropical oceans and in upwelling regions. This study predicts that microbial foodwebs will start to dominate and divert energy from larger plankton foodwebs that reduces carbon drawdown (Heneghen *et al*., 2024). Nutrient addition experiments to offshore NW coastal upwelling systems demonstrated changes in community composition, including potentially harmful Vibrionales bacteria, some of which cause human illness (Gutiérrez-Barral, *et al*., 2024).

- **Foodwebs**: Phytoplankton foodwebs dynamics are controlled by ocean temperature. Warmer temperatures were associated with lowered plankton community stability metrics, and temporal stability was linked to synchrony of predators, consumers and producers in marine and freshwater aquatic systems (Zhao *et al.*, 2023). At Helgoland roads data demonstrate flexible foodweb patterns among marine plankton (Kase *et al.*, 2021). Plankton feedback controls are key to linking biodiversity to ecosystem functioning and were modelled by networks. In more diverse, oligotrophic ecosystems, biodiversity effects are more important than environmental effects (nutrients and temperature) as drivers of biomass (Chang *et al.*, 2022).
- **Recommendations for methodological approach**: Few publications from WGPME integrate different forms of methodology. However, a consortium paper by Galaz García *et al.*, (2023) recommended harmonizing multiple methods, collaboration between marine and wider technology and economic research and business communities.

4 Produce a cooperative joint METABASE informed product in collaboration with WGIMT and WGZE (ToR D)

Based on preferences of intended audiences and general readership trends, WGPME decided to change the format of the *Plankton Status Report* (PSR) from a traditional printed out document to an online information resource featuring phytoplankton and eventually microbial trends alongside abiotic variables with shorter regional summaries and animated, interactive figures. We will be reporting on ICES ecoregions rather than individual sites in order to be congruent with ICES Ecosystem Overviews, although we are including additional Western Atlantic regions in this report. An online format will allow figures to be regularly updated annually for remotely sensed phytoplankton biomass trends, although in situ cell counts will be delayed by 3-4 years as many monitoring stations are working on backlogged sample counts.

This year, a draft report is due in January 2025 as a pdf as an interim measure. All WGPME members have contributed and Metabase subgroup was established with regional leaders meeting once a month, managed overall by R. Stern. The report and online data include 20 regional and a global summary incorporating single coastal sites and open water data from the Continuous Plankton Recorder Survey, that include multiple figures showing trends on Sea surface temperature, salinity, and chlorophyll. The website will also show a matrix of Historical Record Average Temperatures occurring since 2000 for each ICES region. Triangle maps show significant changes in open water trends of major plankton groups diatoms, dinoflagellates, Phytoplankton Colour Index (PCI), and zooplanktonic copepods alongside sea surface temperature and salinity from the CPR survey over 10–60-year time frames. Diatoms and dinoflagellates are the major phytoplankton types recorded by the CPR survey and their ratios to each other are indicators of foodweb flow (Bedford *et al.*, 2020). PCI is a colour index observed on CPR samples by eye using a standard colour shade chart whose patterns were found to be like remotely senses chl-a trends but is not an accurate measure of biomass (Batten *et al.*, 2003, Raitsos *et al.*, 2012). The PSR report focuses on phytoplankton biomass based on long-term recording stations or in situ data and taxa group trends. Microbial trends are not reported here as they are not commonly recorded by WGPME sites. The report is coordinated with WZME datasets and will feed into their status report for easier comparisons. The report format is also similar to global IGMETS report on phytoplankton trends and compatible with the ICES IROC report (ICES Report on Climate).

Outcomes

- Metabase highlights
  - All ICES North Atlantic regions and the Western Atlantic show significant surface warming trends. The last 20 years have seen highest recorded sea surface temperatures in nine of the17 regions of historical average temperatures since 1900 according to Historical Record Average Sea surface Temperatures chart and summary figures (see Figure 1 as an example). This chart includes graphical display of historic temperatures for each ICES ecoregions, with number scale of frequency of highest temperatures that mean all ten of the record temperatures since 1900-2022 happened between 2000–2022. The metabase reports outputs show 58% of ICES Atlantic regions are warming. Five of these are Subarctic to arctic regions, but open water warming shows similar trends.

- Globally, temporal and spatial surface phytoplankton biomass show strong negative trends in many Subarctic regions Celtic and Faroes ecoregions (Figure 2). The report also shows mismatches between Chlorophyll-a (phytoplankton biomass proxy and NPP (Net Primary Productivity): the rate of photosynthetic carbon fixation minus cellular respiration, between 2003-2022. For example, 56% of ICES North Atlantic region shows increasing chlorophyll-a, only 38% of the same area shows increasing NPP. The eastern Atlantic coast show greatest decrease in NPP (Figure 2). This indicates overall decrease in a change in dynamics in the plankton community changing overall production rates and potentially foodwebs.
- Diatom and dinoflagellate trends show variable trends on at different time-scales. However, the 60-year hindcast trend (Figure 3 and 4) show the best climate-relevant scale trends. They demonstrate an east-west trend, with decreasing dinoflagellate and diatoms on the east and increasing trends on the west in general, with the North Sea and Oceanic NorthEast Atlantic showing non-significant mixed patterns overall. This mirrors the general NPP trends.
- In situ PCI from the CPR survey data on phytoplankton biomass trends over the same 20-year period show partial congruence with chl-a remotely sensed data, but not in other regions. The 60-year trends all show significant increases in PCI. In regions of decreasing diatoms and dinoflagellates, this biomass could come from smaller or delicate phytoplankton that are destroyed on collection but retain their colour.

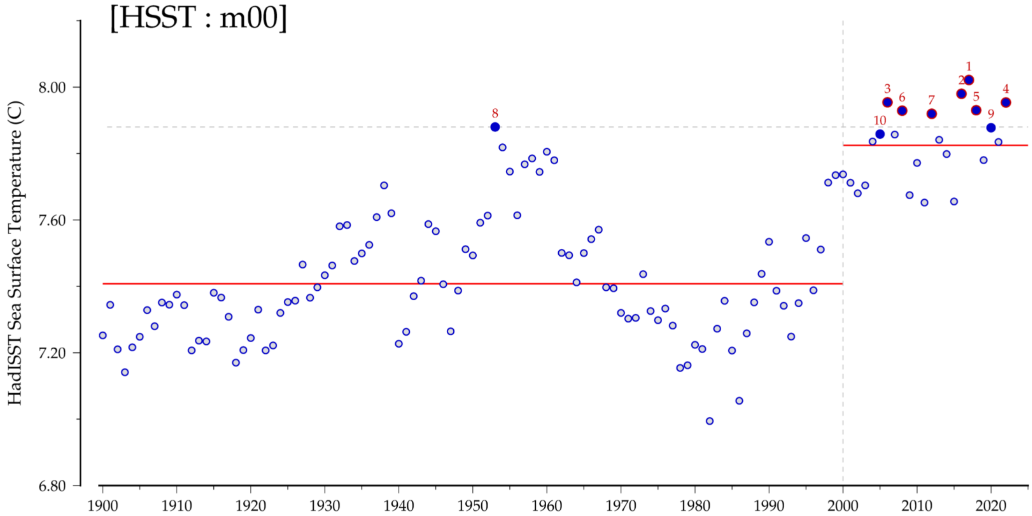


Figure 1: Example of Historical Record Average Temperatures occurring since 2000 in the Atlantic Ocean (produced by T O'Brien) for ICES North Atlantic open ocean region. The blue-grey circles represent year-by-year annual-average (m00) or monthly temperature values from 1900–2022.The **TOP-10 Values (from 1900–2022)** are shown with a **Dark-Blue filled circle** and a red Ranking Number (from 1 to 10). The vertical grey-dashed-line indicates the year 2000 and the horizontal grey-dashed-line marks the highest temperature value seen that year-2000 cut-off. If a TOP-10 Temperature occurs on/after the year 2000 and it has a value higher than any 1900–1999 (horizontal grey-dashed-line) temperatures, it is additionally marked with a red outline surrounding its Dark-Blue filled circle.

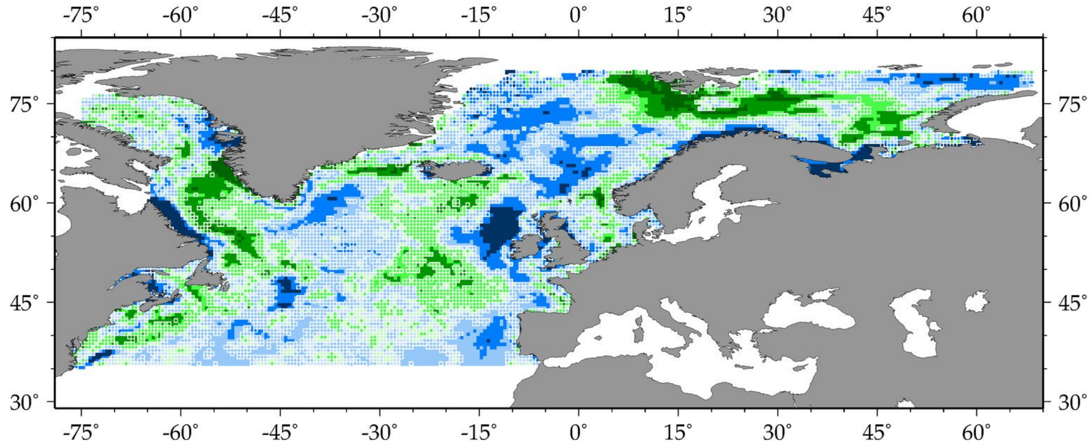


Figure 2: NPP trend over the last 20 years 2003–2022, excluding Baltic Sea. Blue and Green indicate decreasing and increasing trends respectively. The shading indicates significance.

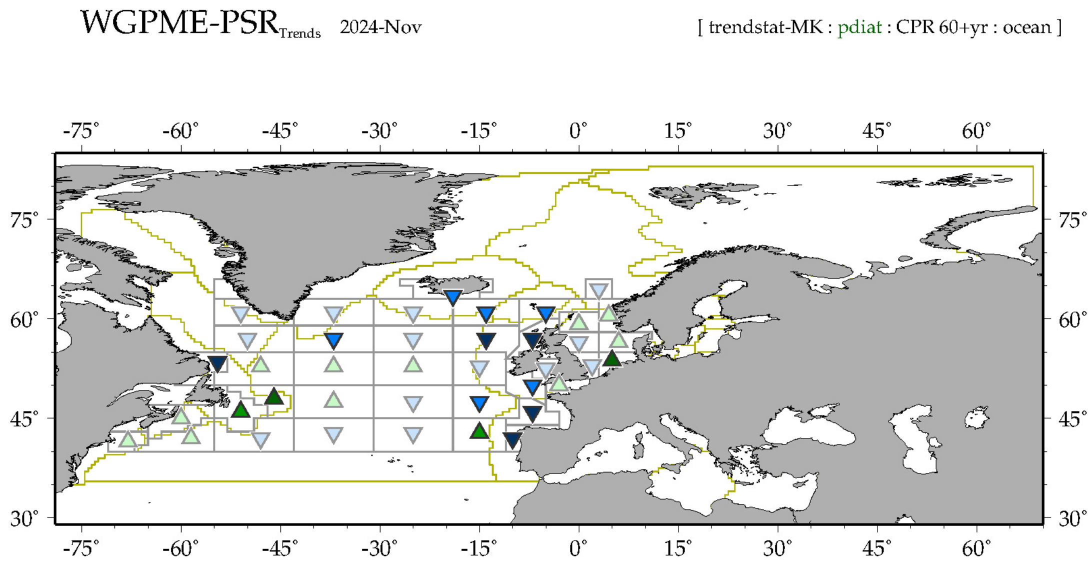


Figure 3: Diatom trend over the last 60 years (1959–2022) from the CPR survey, excluding Baltic Sea not covered by the survey. Yellow lines show ICES ecoregions. Green indicates increase and Blue decrease. The shade indicates significance levels from darkest to lightest shades: $p<0.01$, $p<0.05$ and p (no significant).

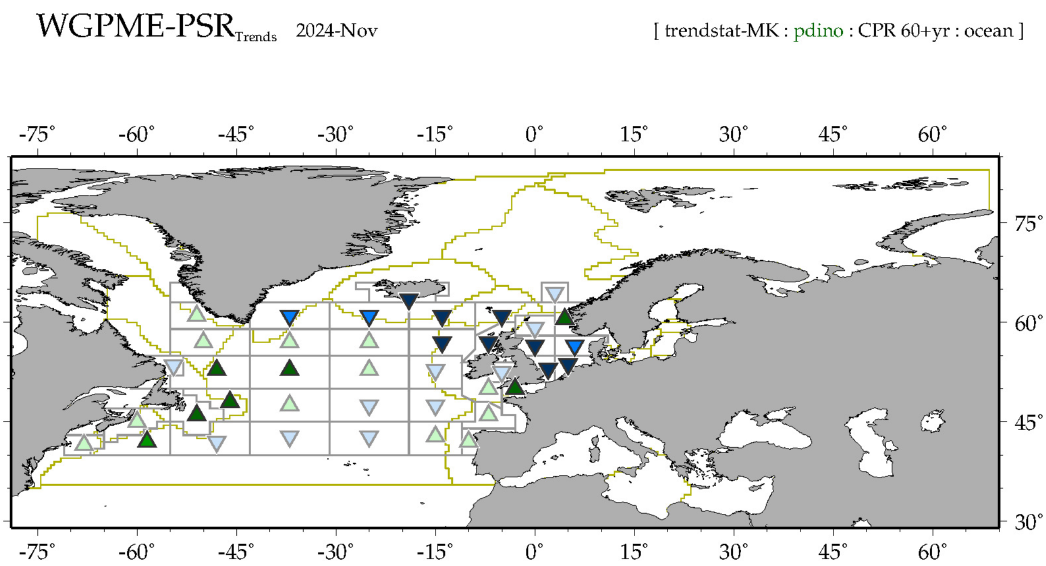


Figure 4: Dinoflagellate trend over the last 60 years (1959–2022) from the CPR survey, excluding Baltic Sea not covered by the survey. Yellow lines show ICES ecoregions. Green indicates increase and Blue decrease. The shade indicates significance levels from darkest to lightest shades: p<0.01, p<0.05 and p (no significant).

5 To create a WGIMT/WGPME/WGZE marine flora and fauna planktonic molecular database (ToR E)

Most of this work relates to the joint development of the North Atlantic barcoding Atlas (MZGdb-NATL) with WGIMT. The groups have added genetic-based phytoplankton taxa to this interactive mapping and data access tool https://wgpme.net/mzgdb/. Biodiversity at the base of the food chain has been identified as an Essential Ocean Variable (EOV) and monitoring biodiversity is regulated in many regions of the North Atlantic through legislations such as the Marine Strategy Framework Directive, that rely on long-term planktonic data. A recent consortium paper of European scientists involved in marine policy including WGPME members has been submitted demonstrating how genetic data can be used alongside other tools in monitoring long-term plankton data (Holland *et al.,* 2024 in submission). Many organisms are now measured using DNA-based methods either alone or in parallel with optical methods such as microscopy or automated imaging tools. The consortium recognized a lack of familiarity of genetic data in those who are not familiar with using genetic data. This reducing the uses and applications of this important source of information. This is due to poor morphological speciation characteristics e.g. jellyfish or bacteria, phytoplankton cysts, the nature of the organisms e.g. parasites or symbionts or simply technical limitations of routine microscopic counting, e.g. phytoplankton flagellates due to size or delicate bodies. Mapping tools for genetic data are rare and often only possible for bespoke datasets. This Atlas visualizes DNA-based taxonomic information, such as DNA barcodes, for ocean phytoplankton and microbial species from common repositories Genbank and Barcode of Life Database. This benefits the overall community as it covers every marine organism from microbes to fish, it helps non-genetic experts view the status of biodiversity that would otherwise be inaccessible to them, it assists experts identify biodiversity knowledge gaps in the ICES ecoregions. The tools use WoRMS as a taxonomic database, which is the basis for many monitoring organizations and by scientists to base their indicator work on for policy. This ToR should continue, to add more data, and to improve quality control and capabilities to this resource.

Members have contributed to seven publications related to this ToR (see Annex 3).

Outcomes

- T O'Brien has authored a book chapter on Metazoogene Atlas demonstrating methodology and uses of this tool (O' Brien *et al.,* 2024).
- WGPME have generated seven publications developing tools or genetically identified taxonomic datasets (Annex 3). Many reflect the maturing nature of genetics that are commonly used for eDNA surveys and even developing standard approaches such as Kramer *et al.* (2024). Jerney *et al.* (2022) published eDNA monitoring standards in Finland and demonstrated the om case studies in seas of Denmark (Jerney *et al.* 2023) and in the Barents Sea (Erikson *et al.*, 2023). Recio *et al.,* (2024) demonstrated translation of eDNA information into functional characterization, a tool needed for ecosystem assessments and indicator development.
- Genetic tools are still used as part of detailed systemic description of new plankton species (Haraguchi *et al*., 2022) which are essential to the curation of species databases.

- The capabilities and quality of the data varies greatly between methods and taxonomic groups. So far, DNA-based taxa do not reflect true species numbers for plankton for various reasons including resolution of the marker and the way taxa are named in Genbank. Continuous curation is needed and thus this ToR will likely be permanent.
- A questionnaire will be set up to determine the taxonomic groups this tool will focus on best approaches and output displays.

6 Incorporate and validate new and emerging groups in monitoring time-series (ToR F)

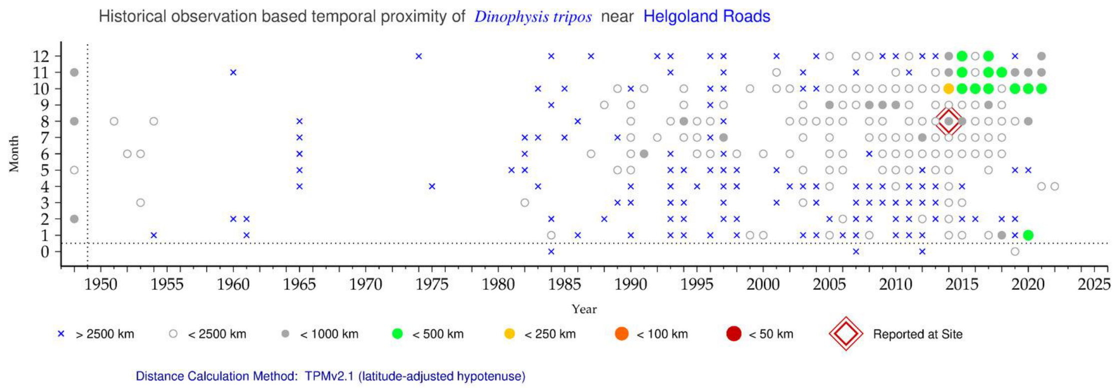
New or rare occurrences of phytoplankton signify long-term oceanographic changes or identify non-native species. This is displayed on ICES WGPME website at https://wgpme.net/first-obs, although the figure formats are outdated. WGPME has recently observed ten new species, new species distributions, and occurrences or re-occurrences in their regions. To distinguish new or returning species, the group noted the value and gaps within long-term, historical records particularly with records over 30 years old where manuscripts and grey literature are not digitized. The ICES historical records are a key resource in observing changing species patterns. This ToR is closely related to ToR E Metazoogene Atlas where many DNA-based taxa and not represented in morphological datasets, thereby delaying the identification and potential management action of these organisms. These observations are at risk of being overlooked or misidentified loosing valuable data on environmental or anthropogenic drivers of these occurrences. To keep track of new and emerging species for different areas this ToR was created and the group will continue this ToR to assist marine managers and scientists locate new and emerging species. A ToR F subgroup has been established (A. Kraberg, T. O' Brien) to manage and develop useful visualization plots (Figure 5) showing temporal and spatial proximity plots and considering additional oceanographic datasets.

Multiple WGPME members (and one WGZE member) have provided rare/first-observation species sightings for use in the tool, representing multiple phytoplankton species (and one copepod) observations in the North Sea, Baltic Sea, English Channel, Subarctic, and northwest North Atlantic. Spatio-temporal comparisons of species against historical observations data provided a variety of interesting patterns. There was often a seasonality to the species presence, with the target species often appearing more and more frequently in the local area during a specific season (e.g. spring or summer). In multiple species, the historical data showed that the species was actually common 20-30 years ago, then almost completely disappeared for a few decades before returning again in recent times. Comparisons with corresponding SST data from the same region and periods often suggested a relationship between temperature and presence (e.g. noticed during an especially warmer or cooler period). This analysis relies heavily on the availability of historical observations from the species in question, usually accessed from the OBIS database. Examples are shown in Figure 5. They include *Mediopyxis* and *Plagiolemma* diatoms in the North Sea (Nézan *et al.*, 2018, Kraberg *et al.*, 2018). Several reports of new harmful algae distributions have been observed including *Dinophysis tripos*, showing its first occurrence in the southern North Sea, but is regularly observed in Celtic shelf seas. Also observed were the potential harmful algae *Aureococcus anophagefferens* in the Western English Channel from 2011-2014 (Stern *et al.*, 2023) and *Gambierdiscus* spp., *Ostreopsis* spp. (Godinho *et al.*, 2021) from benthic substrates in the Madiera and Selvagens Islands (Godhino *et al.*, 2022, Barbosa *et al.*, 2022), shown to be toxic. *Gambierdiscus* spp. were additionally observed in offshore planktonic Iberian Seawaters (Mengs *et al.*, 2023) and Madeira (Hoppenrath *et al.*, 2019). Figure 6 shows images of some of these new species.

Outcomes

- The group has 14 publications relating to this ToR (Annex 3)
- At least 10 new phytoplankton taxa have been reported.
- WGPME identified historic records in the archives of Pangaea: https://doi.org/10.1594/PANGAEA.823084 and the online catalogue of species from VLIZ at 4DEMON: https://www.vliz.be/projects/4demon/catalogue.php?module
- New plot displays show spatial distance of new sighting and temporal plots showing previous reporting from OBIS.
- The group agreed these new taxa should be reported to OBIS that holds long-term plankton records, is open and free and is maintained to high standards.
- Members will flag and update OBIS where updated information is found such as taxonomic name changes or historical sightings from paper records.
- WGPME will host visualization tools that can allow users to determine if this is a new species or a recurrence.
- A subgroup has been formed to write an- opinion paper/review proposal on non-indigenous phytoplankton spp. led by C. Churro and B. Frazao.

A



B

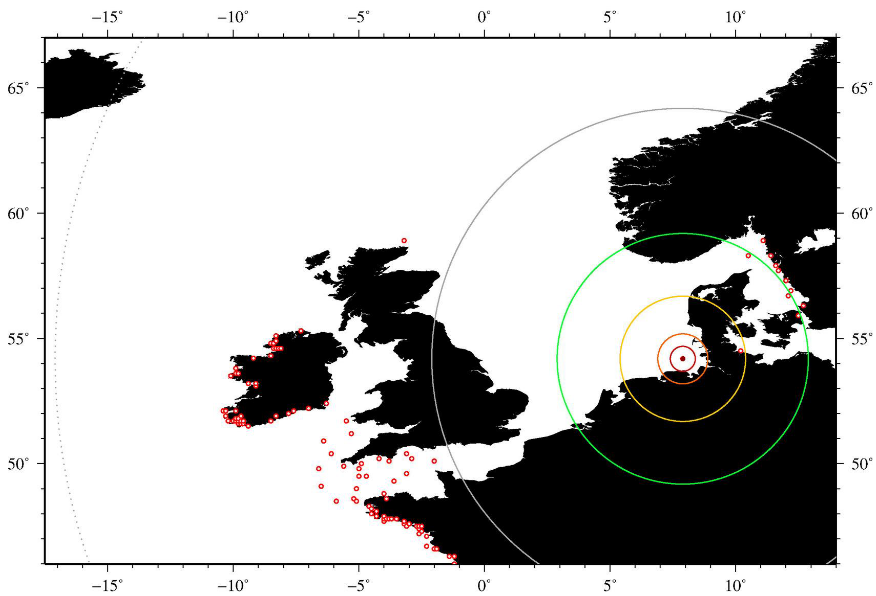


Figure 5: Visualization tools for new or rare phytoplankton species showing (A) temporal and (B) spatial proximities to first sightings. In this case showing *Dinophysis tripos* first observed at Helgoland Roads, North Sea in 2015 in an unusual season and location (normally in the Celtic Seas).

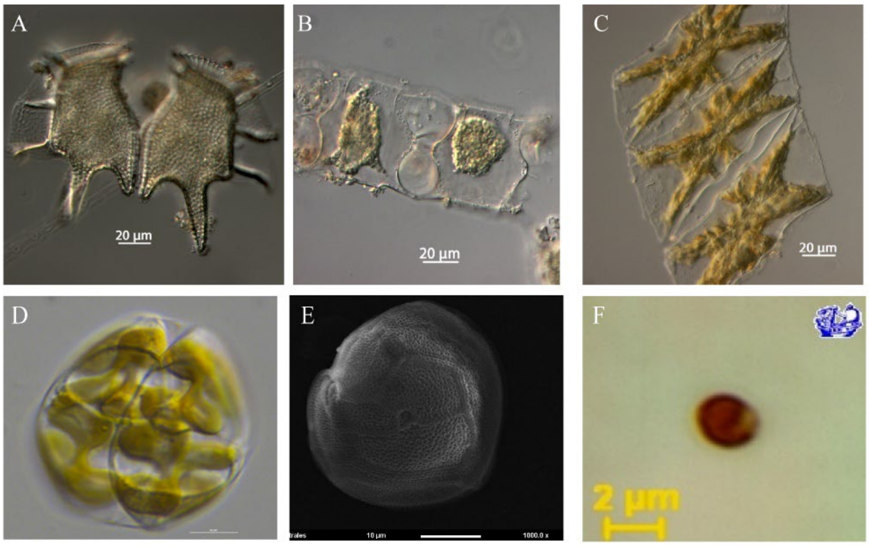


Figure 6 A: *Dinophysis tripos*, B: *Mediopyxsis helysia* C: *Odontella longicrusis,* C: *Plagiolemma distortum*. D: *Gambierdiscus australes*. Images A-D, F from PlanktonNet (planktonnet.awi.de), hosted by AWI, Image E: Pers. comm. Image authors A. Kraberg, C. Widdicombe, (D), C. Churro (E), F. Jouenne. (F).

7 Outreach and communication outputs at ICES

WGPME ToR goals are closely aligned with collaborated with WGZE and WGIMT and have contributed to ToR E in improving taxonomic data access and ToR D: Metabase report figures aligning our plankton status reports. WGPME heard presentation from the SCOR working group TrendsPO that report on global phytoplankton trends. Members belonging to both groups and are coordinating on common ToRs and activities.

WGPME, WGHABD, and WGITMO chairs R. Stern, D. Clarke, and C. McKenzie convened session F "Integration of molecular tools for biodiversity, risk assessment, ecosystem advice within a changing climate" at the ICES Annual Science Conference 2023 in Bilbao, Spain. This was attended by 134 people in person and online with 26 talks and poster sessions, with one winner for poster session F. Theme session report F provided a synthesis of talks, trends on microbial detection methods and applications and made recommendations (ICES 2023).

ICES ASC conference 2023 session F conveners, R. Stern, D. Clarke, C. McKenzie.

Reference list

Bagby SC, Chisholm SW. Response of Prochlorococcus to varying CO2:O2 ratios. ISME J. 2015 Oct;9(10):2232-45. doi: 10.1038/ismej.2015.36

Bar-On, Y. M., Milo, R. 2019 The biomass composition of the oceans: A blueprint of our blue planet. Cell, 179 (7): 1451-1454.

Sonia D. Batten, Anthony W. Walne, Martin Edwards, Stephen B. Groom, Phytoplankton biomass from continuous plankton recorder data: an assessment of the phytoplankton colour index, *Journal of Plankton Research*, Volume 25, Issue 7, July 2003, Pages 697–702,

Bedford, J, Ostle, C, et al. (2020) Lifeform indicators reveal large-scale shifts in plankton across the North-West European shelf. *Glob. Change Biol*. 26: 3482– 3497. https://doi.org/10.1111/gcb.15066.

Bolaños, L.M., Karp-Boss, L., Choi, C.J., Worden, A.Z., Graff, J.R. et al. (2020), Small phytoplankton dominate western North Atlantic biomass, *The ISME Journal*, 14 (7):1663–1674, https://doi.org/10.1038/s41396-020-0636-0

Bucklin, A. K.T.C.A. Peijnenburg, K.N. et al. (2021) Toward a global reference database of COI barcodes for marine zooplankton. Marine Biology. DOI: 10.1007/s00227-021-03887-y.

De Vargas et al. (2015) Eukaryotic plankton diversity in the sunlit ocean. Science 348 (6247): 1261605-1

Edwards, M., Atkinson., Bresnan, E., Helaouet, P., McQuatters-Gollop, A., Ostle, C., Pitois, S. & Widdicombe, C. (2020). Impacts of climate change on Plankton and jellyfish. *MCCIP Science Review 2020*, 321–352. doi: 10.14465/2020.arc15.plk.

Gómez F., Artigas, L.F, Gast, R. J. (2021). Molecular phylogeny and synonymy of Balechina gracilis comb. nov. (= Gymnodinium gracile), a widespread polymorphic unarmored dinoflagellate (Dinophyceae). *J. Phycol*, 57(2), 694-697. https://doi.org/10.1111/jpy.13135.

Gomez F., Artigas, L.F, Gast, R. J. (2019). Molecular phylogeny of the parasitic dinoflagellate Syltodinium listii (Gymnodiniales, Dinophyceae) and generic transfer of Syltodinium undulans comb. nov. (=Gyrodinium undulans). *Eur J Protistol.* 71, 125636 (10p.). https://doi.org/10.1016/j.ejop.2019.125636 (First molecular report).

ICES (2023). Theme Session F – Integration of molecular tools for biodiversity, risk assessment, ecosystem advice within a changing climate. ASC 2023 - Theme session F. Conference contribution. https://doi.org/10.17895/ices.pub.24420700.v1

ICES (2021). Celtic Seas Ecoregion – Ecosystem overview. *In* Report of the ICES Advisory Committee, 2021. ICES Advice 2021, Section 7.1, https://doi.org/10.17895/ices.advice.9432.

Hoppenrath, M., Kretzschmar, A.L., Kaufmann, M.J. *et al.* Morphological and molecular phylogenetic identification and record verification of *Gambierdiscus excentricus* (Dinophyceae) from Madeira Island (NE Atlantic Ocean). *Mar Biodivers Rec* **12**, 16 (2019). https://doi.org/10.1186/s41200-019-0175-4

Karlson, B., Andersen, P., et al. (2021). "Harmful algal blooms and their effects in coastal seas of Northern Europe." Harmful Algae 102: 101989.

Kraberg AC, Widdicombe CE, Beckett R, Rick J, Rooks P, van Wezel R (2018) Further records of a new diatom species in the English Channel and North Sea: the importance of image-referenced data. Marine Biodiversity Records 11:21 doi.org/10.1186/s41200-018-0155-0

Lange, P.K., Werdell, P.J., et al. (2020) Radiometric approach for the detection of picophytoplankton assemblages across oceanic fronts Optical Express 28 (18) 25682. https://doi.org/10.1364/OE.398127

McQuatters-Gollop, A., Stern, R.F., Atkinson, A., Best, M., Bresnan. E, et al. (2024) The silent majority: Pico- and nanoplankton as ecosystem health indicators for marine policy. Ecol, Indic. 159:111650. https://doi.org/10.1016/j.ecolind.2024.111650.

Nézan E, Bilien G, Boulben S, Mertens KN, Chomérat N (2018) Description and phylogenic position of *Plagiolemma distortum* sp. Nov., a new raphid diatom (Bacillariophyceae) from French coastal waters. Diatom Research doi.org/10.1080/0269249X.2018.1468359

O'Brien, T. D., et al. 2021. https://wgpme.net/plankton-status-report

Raitsos, Dionysios & Walne, Anthony & Lavender, Samantha & Licandro, P. & Reid, Philip & Edwards, Martin. (2012). A 60-year ocean colour data set from the continuous plankton recorder. Journal of Plankton Research. 35. 158-164. 10.1093/plankt/fbs079.

Schmidt, K, Birchill, AJ, et al. (2020) Increasing picocyanobacteria success in shelf waters contributes to long-term foodweb degradation. *Glob Change Biol*. 26: 5574– 5587. https://doi.org/10.1111/gcb.15161

Vaulot D, Marie D, Olson RJ, Chisholm SW. (1995). Growth of *Prochlorococcus*, a photosynthetic prokaryote, in the equatorial Pacific Ocean. Science 268: 1480–1482

Annex 1: List of participants

Attendees at the 2022-2024 meeting

Name	Institute	Country (of institute)
Alexandra Kraberg	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research	Germany
Anders Lanzen	AZTI-Tecnalia	Spain
Anneke van den Oever	Bureau Waardenburg Vestiging Noord	Netherlands
Arnaud Louchart	Netherlands Institute of Ecology (NIOO-KNAW)	France
Arnoud Louchart	Universite Littoral	France
Bárbara Frazão e Teixeria	Portuguese Institute for the Sea and the Atmosphere	Portugal
Caterina Churro	Portuguese Institute for the Sea and the Atmosphere	Portugal
Christian Lønborg	Aarhus University	Denmark
Claire Widdicombe	Plymouth Marine Laboratory	UK
Diana Vaičiūtė	Klaipeda University	Lithuania
Eileen Bresnan	Marine Scotland	UK
Emmanuel Devred	Fisheries and Oceans Canada	Canada
Eva Teira	University of Vigo, Department of Ecology and Animal Biology	Spain
Felipe Artigas	Laboratoire d'Océanologie et de Géosciences	France
Felix Sproll	Marine Institute Galway	Ireland
Gayantonia Franze	Institute of Marine Research	Norway
Glaucia Moreira Fragoso	Norwegian University of Science and Technology	Norway
Glen Taran	Plymouth Marine Laboratory	UK
Hans Jacobsen	Aarhus University	Denmark
Heidi Sosik	Woods Hole Oceanographic Institution	USA
Ian Salter	Faroe Marine Research Institute	Faroe Islands
Isabel Ferrera	Centro Oceanográfico de Málaga	Spain
Iveta Jurgensone	Latvian Institute of Aquatic Ecology	Latvia

Name	Institute	Country (of institute)
Jacob Carstensen (guest)	Aarhus University	Denmark
Joe Silke	Marine Institute	Ireland
Jonathan Kelly	Marine Institute	Ireland
Laura Käse	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research	Germany
Marie Johansen	Swedish Meteorological and Hydrological Institute	Sweden
Marina Chifflet	AZTI-Tecnalia	Spain
Nicolas Record	Bigelow Laboratory for Ocean Sciences	USA
Nicole Poulton	Bigelow Laboratory for Ocean Sciences	USA
Renata Pilkaitytė	Klaipeda University	Lithuania
Rowena Stern	Independent/Consultant	UK
Sarah Lerch	Institute of Marine Research	Norway
Sirpa Lehtinen	Finnish Environment Institute	Finland
Siv Huseby	Umeå Marine Sciences Centre	Sweden
Todd O’Brien	NOAA	USA
Veronique Creach	Centre for Environment, Fisheries and Aquaculture Science	UK
Veronique Creach	Cefas	UK
Xosé Auxelu G. Morán	Centro Oceanográfico de Gijón/Xixón	Spain

Annex 2: Resolutions

Working Group on Phytoplankton and Microbial Ecology (WGPME)

2021/FT/EPDSG04 The **Working Group on Phytoplankton and Microbial Ecology** (WGPME), chaired by Rowena Stern, UK and Nicole Poulton, USA will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2022	13–14 June, 2022	Online meeting		
Year 2023	20-23 March	ICES HQ, Copenhagen, Denmark		
Year 2024	13–17 May	ICES HQ, Copenhagen, Denmark	Final report by DATE to SCICOM	

ToR descriptors

ToR	Description	Background	Science Plan Codes	Duration	Expected Deliverables
a	Generate improved knowledge of small food web components that are poorly monitored/assessed	There is a lack of consideration of smaller phytoplankton in monitoring and assessment studies which make up majority of plankton diversity and in some areas biomass. With the advent of flow cytometry, genetics and imaging, small phytoplankton datasets have been collected over a reasonable time series to be useful in ecological studies but many are not available/accessible to the general scientific community. To assist in the use of smaller phytoplankton for ocean studies, we will collate smaller phytoplankton data sources into a database available on WGPME and GLOMICON based on a questionnaire to engage other users.	1.3	3 years	To deliver data on smaller phytoplankton to GLOMICON for improved research access to pico/nano-phytoplankton datasets. Based on the quality/quantity of data collated, we will assess if a synthesis paper could be written.
b	Update on Explore the use of indicators for Knowledge Exchange	Many WGPME members are involved in developing phytoplankton/microbial indicators but at regional levels that can differ in approach and in many cases. This an ongoing process and there are few	1.3; 4.1; 4.4	ongoing	The group will review and evaluate available science dealing with indicator development as needed. Annual national updates on the

		opportunities to compare approaches or results. Therefore, this ToR continues from the previous term but the aim changed to an ongoing knowledge exchange activity to guide members new to developing indicators for their region.			topic will be requested from EG members and summary into ICES reports.
c	Conduct an integrated analysis of phytoplankton and microbial plankton responses to global warming.	Understand consequences of long-term changes e.g. in phenology and body size for foodweb functioning and associated eco-system services. This is a continuation of ToR d from the previous term that was delayed due to member change and COVID but still considered an important output.	1.3; 2.5	3 years	A research paper on picoplankton to be written.
d	Produce a cooperative joint METABASE informed product in collaboration with WGIMT and WGZE	To produce a more user-friendly guide on trends in phytoplankton and zooplankton from METABASE on WGPME/WGZE website (e.g., https://wgpme.net/metabase), extracting key trends in phytoplankton and zooplankton assessing their relevance and to write a short research paper or short report depending on the findings.	1.3; 1.9	ongoing to review every 3 years	Cooperative Phytoplankton/ Zooplankton report or paper
e	To create a WGIMT/WGPME/WGZE marine flora and fauna planktonic molecular database	North Atlantic barcoding Atlas with WGIMT and WGZE to produce a geographic guide of genetically-acquired plankton taxa aimed at non-genetic specialists. To hold a joint session with WGHABD and other EGs to discuss molecular tools for different ecological questions and relevance for policy.	1.7	3 years	Incorporation of phytoplankton DNA barcoding taxa into barcoding Atlas (https://wgimt.net/atlas) Proposal of a special joint ASC 2023 session as knowledge exchange.
f	To create a mapping tool to report new and rare taxa observations in the North Atlantic.	First Records database will be developed for new species sightings. New sightings often indicate habitat change. We will develop a web-based interactive geographic tool to improve validation across multiple monitoring stations and for ecological synthesis. The new sightings will be recorded continuously and reviewed every three years to write a paper or provide information to other ICES expert groups.	3.3; 4.1	ongoing review every 3 years	A template database populated by content on WGPME and/ or other sites

Summary of the Work Plan

Year 1	Data gathering for input into online databases for ToR a, ToR e, ToR f, ToR g.
Year 2	Review data and decide on which papers to write or a short report for ToR e,
Year 3	Review 3 years of data for ToR a, ToR e, ToR g

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.
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.
Participants	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities	Standard EG 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 very close working relationship with WGZE. It is also very relevant to WGHABD and WGIMT.
Linkages to other organizations	R. Stern is also a member of SCOR Metazoogene and member of WGIMT, other members beloing to WGHABD and IOC. Other information assists in exchange of indicator development that feeds back to relevant national science advisory organisations e.g. HELCOM or OSPAR.

Annex 3: Publications of WGPME members

Year	Reference	ToR 1	ToR 2	ToR 3
2024	S Barton, M Yang, C Batchelor-McAuley, E Mitchell, H Chen, CE Widdicombe, GL Wheeler, RG Compton, HA Bouman, REM Rickaby (2024) Fluoro-Electro-chemistry Based Phytoplankton Bloom Detection and Enumeration; Field Validation of a New Sensor for Ocean Monitoring. ACS ES&T Water, 4, 11, 4858-4871. DOI: 10.1021/acsestwater.4c00530	A		
2024	Borremans, C., J. Durden, T. Schoening, E. Curtis, L. Adams, A. B. Albu, A. Arnaubec, S.-D. Ayata, R. Baburaj, C. Bassin, M. Beck, K. Bigham, R. Boschen-Rose, C. Collett, M. Contini, P. Correa, C. Dominguez-Carrió, G. Dreyfus, G. Duncan, M. Ferrera, V. Foulon, A. Friedman, S. Gaikwad, C. Game, A. Gaytán-Caballero, F. Girard, M. Giusti, M. Hanafi-Portier, K. Howell, I. Hulevata, K. Itiowe, C. Jackett, J. Jansen, C. Karthäuser, K. Katija, M. Kernec, G. Kim, M. Kitahara, D. Langenkämper, T. Langlois, N. Lanteri, C. J. Li, Q.-R. Li, P.-O. Liabot, D. Lindsay, A. Loulidi, Y. Marcon, S. Marini, A. Marranzino, M. Massot-Campos, M. Matabos, L. Menot, B. Moreno, M. Morrissey, D. Nakath, T. Nattkemper, M. Neufeld, M. Obst, K. Olu, A. Parimbelli, F. Pasotti, D. Pelletier, M. Perhirin, N. Piechaud, O. Pizarro, A. Purser, C. Rodrigues, E. C. Romero, B. Schlining, Y. Song, H. Sosik, M. Sourisseau, B. Taormina, J. Taucher, B. Thornton, L. V. Audenhaege, C. von der Meden, G. Wacquet, J. Williams, K. Witting, and M. Zurowietz. 2024. Report on the Marine Imaging Workshop 2022. Research Ideas and Outcomes 10: e119782. https://doi.org/10.3897/rio.10.e119782	A		

2022	Thyssen, M., G. Grégori, V. Creach, S. Lahbib, M. Dugenne, H. M. Aardema, L.-F. Artigas, B. Huang, A. Barani, L. Beaugeard, A. Bellaaj-Zouari, A. Beran, R. Casotti, Y. Del Amo, M. Denis, G.B.J. Dubelaar, S. Endres, L. Haraguchi, B. Karlson, C. Lambert, A. Louchart, D. Marie, G. Moncoiffé, A. Noordeloos, D. Pecqueur, F. Ribalet, M. Rijkeboer, T. Silovic, R. Silva, S. Marro, H.M. Sosik, M. Sourisseau, G. Tarran, N. Van Oostende, L. Zhao, S. Zheng. 2022. Interoperable vocabulary for marine microbial flow cytometry. Frontiers in Marine Science. 9: 975877. https://doi.org/10.3389/fmars.2022.975877	A		
2022	Boss, E., A.M. Waite, J. Karstensen, T. Trull, F. Muller-Karger, H.M. Sosik, J. Uitz, S. G. Acinas, K. Fennel, I. Berman-Frank, S. Thomalla, H. Yamazaki, S. Batten, G. Gregori, A.J. Richardson, and R. Wanninkhof. 2022. Recommendations for plankton measurements on OceanSITES moorings with relevance to other observing sites. Frontiers in Marine Science 9. https://doi.org/10.3389/fmars.2022.929436	A		
2024	McQuatters-Gollop, A., Stern, R.F., Atkinson, A., Best, M., Bresnan. E, et al. (2024) The silent majority: Pico- and nanoplankton as ecosystem health indicators for marine policy. Ecol, Indic. 159:111650. https://doi.org/10.1016/j.ecolind.2024.111650.	B	C	A
2023	Sagaminarga, Y., Garcés, E., Francé, G., Stern, R., Revilla, M et al. (2023). New tools and recommendations for a better management of harmful algal blooms under the European Marine Strategy Framework Directive. Front Ocean Sustain.1. https://doi.org/10.3389/focsu.2023.1298800	B		
2023	Holland, M., Louchart, A., Artigas, L. F. and McQuatters-Gollop, A. 2023. Changes in Phytoplankton and Zooplankton Communities. In: OSPAR, 2023: The 2023 Quality Status Report for the Northeast Atlantic. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-statusreports/qsr-2023/indicator-assessments/changes-plankton-communities/	B		

2023	Louchart, A., Holland, M., McQuatters-Gollop, A. and Artigas, L. F. 2023. Changes in Phytoplankton Biomass and Zooplankton Abundance. In: OSPAR, 2023: The 2023 Quality Status Report for the Northeast Atlantic. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/changes-plankton-biomass-abundance	B		
2023	Louchart, A., Holland, M., McQuatters-Gollop, A. and Artigas, L. F. 2023. Changes in plankton diversity. In: OSPAR, 2023: The 2023 Quality Status Report for the Northeast Atlantic. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/changes-plankton-diversity/	B		
2023	Louchart, A., Lizon, F., Claquin, P., Artigas, L. F., 2022. Pilot assessment on primary production. In: OSPAR, 2023: The 2023 Quality Status Report for the North-East Atlantic. OSPAR Commission, London. Available at: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicatorassessments/primary-prod-pilot-assessment/	B		
2021	C Ostle, K Paxman, CA Graves, M Arnold, LF Artigas, A Atkinson, A Aubert, M Baptie, B Bear, J Bedford, M Best, E Bresnan, R Brittain, D Broughton, A Budria, K Cook, M Devlin, G Graham, N Halliday, P Hélaouët, M Johansen, DG Johns, D Lear, M Machairopoulou, A McKinney, A Mellor, A Milligan, S Pitois, I Rombouts, C Scherer, P Tett, C Widdicombe, A McQuatters-Gollop (2021) The Plankton Lifeform Extraction Tool: a digital tool to increase the discoverability and usability of plankton time-series data. EARTH SYSTEM SCIENCE DATA.13: 5617-5642. DOI:10.5194/essd-13-5617-2021	B		

2023	Kownacka, J., Busch, B., Göbel, J., Gromisz, S., Hällfors, H., Höglander, H., Huseby, S., Jaanus, J., Jakobsen, H.H., Johansen, H., Johansson, M., Jurgensone, I., Liebeke, N., Kobos, J., Kraśniewski, W., Kremp, A., Lehtinen, S., Olenina, I., Weber, M.W. and Wasmund, N. 2023 https://helcom.fi/wp-content/uploads/2023/03/BSEFS-Cyanobacteria-biomass-1990-2021.pdfCyanobacteria biomass, 1990-2021 -Information from the Phytoplankton Expert Group (PEG), p. 18, HELCOM, Helsinki	B		
2021	Karlson B., Andersen P., Arneborg L., Cembella A., Eikrem W., John U., West J.J., Klemm K., Kobos J., Lehtinen S., Lundholm N., Mazur-Marzec H., Naustvoll L., Poelman M., Provoost P., De Rijcke M., Suikkanen S. (2021) Harmful algal blooms and their effects in coastal seas of Northern Europe. Harmful Algae, https://doi.org/10.1016/j.hal.2021.101989	B		
2021	Haraguchi,L.,Lehtinen,S.,Attila,J.,Alasalmi,H.,Lindholm,M.,Kraft,K.,Velhonoja,O.,Kuuppo,K.,Tamminen,T.,Seppälä,J. 2021 The evolution of cyanobacteria bloom observation in the Baltic Sea. Pp. 30–31 in Frontiers in Ocean Observing: Documenting Ecosystems, Understanding Environmental Changes, Forecasting Hazards. E.S. Kappel, S.K. Juniper, S. Seeyave, E. Smith, and M. Visbeck, eds, A Supplement to Oceanography 34(4), https://doi.org/10.5670/oceanog.2021.supplement.02-13.	B		
2021	van den Oever, A., Sanjabi, B., Bultstra, C.A., Verweij, G.L. 2022. Fytoplanktononderzoek in de zoute Rijkswateren MWTL 2021. BM 22.06, Bureau Waardenburg Rapportnr. 22-091a. Bureau Waardenburg, Culemborg.	B		
2022	van den Oever, A., Sanjabi, B. 2023. Fytoplanktononderzoek in de zoute Rijkswateren MWTL 2022. Rapportnr. 23-069a. Waardenburg Ecology, Culemborg.	B		
2023	van den Oever, A., Sanjabi, B., Japink, M. 2024. Fytoplanktononderzoek in de zoute Rijkswateren, MWTL 2023. Rapport 24-0148a Waardenburg Ecology, Culemborg.	B		

2022	Orenstein, E. C., S.-D. Ayata, F. Maps, É. C. Becker, F. Benedetti, T. Biard, T. de Garidel-Thoron, J. S. Ellen, F. Ferrario, S. L. C. Giering, T. Guy-Haim, L. Hoebeke, M. H. Iversen, T. Kiørboe, J.-F. Lalonde, A. Lana, M. Laviale, F. Lombard, T. Lorimer, S. Martini, A. Meyer, K. O. Möller, B. Niehoff, M. D. Ohman, C. Pradalier, J.-B. Romagnan, S.-M. Schröder, V. Sonnet, H. M. Sosik, L. S. Stemmann, M. Stock, T. Terbiyik-Kurt, N. Valcárcel-Pérez, L. Vilgrain, G. Wacquet, A. M. Waite, and J.-O. Irisson. 2022. Machine learning techniques to characterize functional traits of plankton from image data. Limnology and Oceanography 67: 1647-1669. https://doi.org/10.1002/lno.12101	B		
2022	Pinhassi, J., Farnelid, H., García, S.M., Teira, E., Galand, P.E., Obernosterer, I., Quince, C., Vila-Costa, M., Gasol, J.M., Lundin, D., Andersson, A.F., Labrenz, M., Riemann, L. Functional responses of key marine bacteria to environmental change – toward genetic counselling for coastal waters (2022) Frontiers in Microbiology	B	C	
2021	Neeley, A., Beaulieu, S., Proctor, C., Cetinić, I., Futrelle, J., Soto Ramos, I., Sosik, H., Devred, E., Karp-Boss, L., Picheral, M., Poulton, N., Roesler, C., and Shepherd, A. 2021: Standards and practices for reporting plankton and other particle observations from images. 38pp. DOI: 10.1575/1912/27377.	B		
2023	Gutiérrez-Barral, A., Fernández, E., Hernández-Ruiz, M., Teira, E. Contrasting resistance of prokaryotic plankton biomass and community composition to experimental nutrient inputs in a coastal upwelling system (NW Spain) (2023)	B		
2024	Gutiérrez-Barral, A., Teira, E., Díaz-Alonso, A., Justel-Díez, M., Kaal, J., Fernández,E. Impact of wildfire ash on bacterioplankton abundance and community composition in a coastal embayment (Ría de Vigo, NW Spain) (2024) Marine Environmental Research, 194.	B		
2024	Salter, I., Mortensen. E. A registry of Phytoplankton diversity in Faroese Shelf waters: Combining results from the Faroese Marine Ecosystem Observing Study (FAMEOS) with historical records	B	F	

2021	Laura Käse, Katja Metfies, Alexandra C Kraberg, Stefan Neuhaus, Cédric L Meunier, Karen H Wiltshire, Maarten Boersma, Metabarcoding analysis suggests that flexible foodweb interactions in the eukaryotic plankton community are more common than specific predator–prey relationships at Helgoland Roads, North Sea, ICES Journal of Marine Science, Volume 78, Issue 9, November 2021, Pages 3372–3386, https://doi.org/10.1093/icesjms/fsab058	C		
2024	Fernández-Martínez, M., Barquín, J., Bonada, N., Cantonati, M., Churro, C., Corbera, J., Delgado, C., Dulsat-Masvidal, M., Garcia, G., Margalef, O., Pascual, R., Peñuelas, J., Preece, C., Sabater, F., Seiler, H., Zamora-Marín, J. M., & Romero, E. (2024). Mediterranean springs: Keystone ecosystems and biodiversity refugia threatened by global change. Global change biology, 30(1), e16997. https://doi.org/10.1111/gcb.16997	C		
2023	Mengs, G.; Stern, R.F.; Clarke, J.L.*; Faith, M.; Medlin, L.K. (2024) Mapping Selected Emergent Marine Toxin-Producing Organisms Using Historical Samples with Two Methods (Biosensors and Real-Time PCR): A Comparison of Resolution. Appl. Microbiol. 4, 312-328. https://doi.org/10.3390/applmicrobiol4010021.	C	E	F
2023	Stern, R., Picard, K., Clarke, J.*, Walker, C.,E,* Martins, C. et al. (2023) Composition and Patterns of Taxa Assemblages in the Western Channel Assessed by 18S Sequencing, Microscopy and Flow Cytometry J. Mar. Sci. Eng. 2023, 11(3), 480; doi.org/10.3390/jmse11030480.	C	A	
	Stern, R., Picard, K., Clarke, J.*, Walker, C.,E,* Martins, C. et al. (2023) Composition and Patterns of Taxa Assemblages in the Western Channel Assessed by 18S Sequencing, Microscopy and Flow Cytometry supplementary data on flow cytometry, genetically identified plankton species https://www.mdpi.com/article/10.3390/jmse11030480/s1,	C	A	F

2024	MR Jones, R Chance, T Bell, O Jones, DC Loades, R May, L Tinel, K Weddell, C Widdicombe, L Carpenter (2024) Iodide, iodate & dissolved organic iodine in the temperate coastal ocean. FRONTIERS IN MARINE SCIENCE, 11. DOI:10.3389/fmars.2024.177595	C		
2023	AJ McEvoy, A Atkinson, RL Airs, R Brittain, I Brown, ES Fileman, HS Findlay, CL McNeill, C Ostle, TJ Smyth, PJ Somerfield, K Tait, GA Tarran, S Thomas, CE Widdicombe, EMS Woodward, A Beesley, DVP Conway, J Fishwick, H Haines, C Harris, R Harris, P Helaouet, D Johns, PK Lindeque, T Mesher, A McQuatters-Gollop, J Nunes, F Perry, AM Queiros, A Rees, S Ruhl, D Sims, R Torres, S Widdicombe (2023) The Western Channel Observatory: a century of physical, chemical and biological data compiled from pelagic and benthic habitats in the western English Channel. EARTH SYSTEM SCIENCE DATA.15: 5701-5737. DOI:10.5194/essd-15-5701-2023	C		
2023	C Walker, S Corrigan, C Daniels, C Wilding, EMS Woodward, CE Widdicombe, DA Smale, IGC Ashton, AR Brown (2023) Field assessment of the potential for small scale co-cultivation of seaweed and shellfish to regulate nutrients and plankton dynamics. AQUACULTURE REPORTS 33. DOI:10.1016/j.aqrep.2023.101789	C		
2023	L Branscombe, EL Harrison, ZYD Choong, C Swink, M Keys, C Widdicombe, WH Wilson, M Cunliffe, K Helliwell (2023) Cryptic bacterial pathogens of diatoms peak during senescence of a winter diatom bloom. NEW PHYTOLOGIST. DOI:10.1111/nph.19441	C	F	
2023	QH Zhao, PJ Van den Brink, C Xu, SP Wang, AT Clark, C Karakoç, G Sugihara, CE Widdicombe, A Atkinson, SS Matsuzaki, R Shinohara, SQ He, YYXG Wang, F De Laender (2023) Relationships of temperature and biodiversity with stability of natural aquatic foodwebs. NATURE COMMUNICATIONS. 14. DOI:10.1038/s41467-023-38977-6	C		

	RL Airs, R Beale, L Polimene, Y Chen, MA Mausz, DJ Scanlan, CE Widdicombe, GA Tarran, EMS Woodward, C Harris, A McEvoy (2023) Seasonal measurements of the nitrogenous osmolyte glycine betaine in marine temperate coastal waters. BIOGEOCHEMISTRY. 162: 309-323. DOI:10.1007/s10533-022-01006-7	C		
2022	E McCluskey, RJW Brewin, Q Vanhellemont, O Jones, D Cummings, G Tilstone, T Jackson, C Widdicombe, EMS Woodward, C Harris, PJ Bresnahan, T Cyronak, AJ Andersson (2022) On the Seasonal Dynamics of Phytoplankton Chlorophyll-a Concentration in Nearshore and Offshore Waters of Plymouth, in the English Channel: Enlisting the Help of a Surfer. OCEANS-SWITZERLAND. 3: 125-146. DOI:10.3390/oceans3020011	C		
2022	MA Mausz, RL Airs, JL Dixon, CE Widdicombe, GA Tarran, L Polimene, S Dashfield, R Beale, DJ Scanlan, Y Chen (2022) Microbial uptake dynamics of choline and glycine betaine in coastal seawater. LIMNOLOGY AND OCEANOGRAPHY. 67: 1052-1064. DOI:10.1002/lno.12056	C	A	
2022	CW Chang, T Miki, H Ye, S Souissi, R Adrian, O Anneville, H Agasild, S Ban, Y Be'eri-Shlevin, YR Chiang, H Feuchtmayr, G Gal, S Ichise, M Kagami, M Kumagai, X Liu, SIS Matsuzaki, MM Manca, P Noges, R Piscia, M Rogora, FK Shiah, SJ Thackeray, CE Widdicombe, JZ Wu, T Zohary, CH Hsieh (2022) Causal networks of phytoplankton diversity and biomass are modulated by environmental context. NATURE COMMUNICATIONS. 13. DOI:10.1038/s41467-022-28761-3	C		
2022	CM Mutshinda, A Mishra, ZV Finkel, CE Widdicombe, AJ Irwin (2022) Bayesian two-part modelling of phytoplankton biomass and occurrence. HYDROBIOLOGIA. 849: 1287-1300. DOI:10.1007/s10750-021-04789-2	C		

2022	AR Brown, MKS Lilley, J Shutler, C Widdicombe, P Rooks, A McEvoy, R Torres, Y Artioli, G Rawle, J Hom yard, CR Tyler, C Lowe (2022) Harmful Algal Blooms and their impacts on shellfish mariculture follow regionally distinct patterns of water circulation in the western English Channel during the 2018 heatwave. HARMFUL ALGAE. 111. DOI:10.1016/j.hal.2021.102166	C		
2021	V Agarwal, CC James, CE Widdicombe, AD Barton (2021). Intraseasonal predictability of natural phytoplankton population dynamics. ECOLOGY AND EVOLUTION. 11: 15720-15739. DOI:10.1002/ece3.8234	C		
2022	M Lehtiniemi, E Fileman, H Hällfors, H Kuosa, S Lehtinen, I Lips, O Setälä, S Suikkanen, J Tuimala, C Widdicombe (2022) Optimising sampling frequency for monitoring heterotrophic protists in a marine ecosystem. ICES JOURNAL OF MARINE SCIENCE 79: 925-936. DOI:10.1093/icesjms/fsab132	C		
2021	JF Rontani, L Smik, F Vaultier, C Widdicombe, ST Belt (2021) Seasonal monitoring of lipid degradation processes in the western English Channel links bacterial 10S-DOX enzyme activity to free fatty acid production by phytoplankton. MARINE CHEMISTRY. 230. DOI:10.1016/j.marchem.2021.103928	C		
2021	A Atkinson, MKS Lilley, AG Hirst, AJ McEvoy, GA Tarran, C Widdicombe, ES Fileman, EMS Woodward, K Schmidt, TJ Smyth, PJ Somerfield (2021) Increasing nutrient stress reduces the efficiency of energy transfer through planktonic size spectra. LIMNOLOGY AND OCEANOGRAPHY. 66: 422-437. DOI:10.1002/lno.11613	C		
2022	Skouroliakou DI, Breton E, Irion S, Artigas LF, Christaki U. Stochastic and Deterministic Processes Regulate Phytoplankton Assemblages in a Temperate Coastal Ecosystem. Microbiol Spectr. 2022 Dec 21;10(6):e0242722. doi: 10.1128/spectrum.02427-22.	C		

2023	Holland, M.M., Louchart, A., Artigas, L.F., Ostle, C., Atkinson, A., Rombouts, I., Graves, C.A., Devlin, M., Heyden, B., Machairopoulou, M., Bresnan, E., Schilder, J., Jakobsen, H.H., Lloyd-Hartley, H., Tett, P., Best, M., Goberville, E. and McQuatters-Gollop, A. 2023. Major declines in NE Atlantic plankton contrast with more stable populations in the rapidly warming North Sea. Science of the Total Environment 898.	C		
2023	Jensen, M.B., Perini, L., Halbach, L., Jakobsen, H., Haraguchi, L., Ribeiro, S., Tranter, M., Benning, L.G. and Anesio, A.M. 2023. The dark art of cultivating glacier ice algae. Botany Letters.	C		
2021	Lehtinen,S.,Suikkanen,S.,Hällfors,H.,Tuimala,J.,Kuosa,H. 2021 Phytoplankton Morpho-Functional Trait Variability along Coastal Environmental Gradients. Microorganisms 2021, 9, 2477. https://doi.org/10.3390/microorganisms9122477	C	B	
2021	Kraft K., Seppälä J., Hällfors H., Suikkanen S., Ylöstalo P., Anglès S., Kielosto S., Kuosa H., Laakso L., Honkanen M., Lehtinen S., Oja J., Tamminen T. (2021) First Application of IFCB High-Frequency Imaging-in-Flow Cytometry to Investigate Bloom-Forming Filamentous Cyanobacteria in the Baltic Sea. Front. Mar. Sci. 8:594144. doi: 10.3389/fmars.2021.594144	C	B	
2022	Garate, Leire & Alonso-Sáez, Laura & Revilla, Marta & Logares, Ramiro & Lanzén, Anders. (2022). Shared and contrasting associations in the dynamic nano- and picoplankton communities of two close but contrasting sites from the Bay of Biscay. Environmental Microbiology. 24. 10.1111/1462-2920.16153.	C		
2024	Marañón E, Fernández-González C, Tarran GA (2024) Effect of temperature, nutrients and growth rate on picophytoplankton cell size across the Atlantic Ocean. Scientific Reports, 14, 28034	C		
2022	Fernández-González C, Tarran GA, Schuback N, Woodward EMS, Arístegui J, Marañón E (2022) Phytoplankton responses to changing temperature and nutrient availability are consistent across the tropical and subtropical Atlantic. Communications Biology, 5, Article no. 1035	C		

2021	Cabrerizo MJ, Marañón E, Fernández-González C, Alonso-Núñez A, Larsson H, Aranguren-Gassis M (2021) Temperature fluctuation attenuates the effects of warming in estuarine microbial plankton communities. Frontiers in Marine Science, 8	C		
2022	Tunēns, J., Aigars, J., Poikāne, R., Jurgensone, I., Labucis, A., Labuce, A., ... & Vīksna, A. (2022). Stable carbon and nitrogen isotope composition in suspended particulate matter reflects seasonal dynamics of phytoplankton assemblages in the Gulf of Riga, Baltic Sea. Estuaries and Coasts, 45(7), 2112-2123.	C		
2022	Liepina-Leimane, I., Barda, I., Jurgensone, I., Labucis, A., Suhareva, N., Kozlova, V., ... & Aigars, J. (2022). Seasonal dynamic of diazotrophic activity and environmental variables affecting it in the Gulf of Riga, Baltic Sea. FEMS Microbiology Ecology, 98(12), fiac132.	C		
2023	Labucis, A., Labuce, A., Jurgensone, I., Barda, I., Andersone, I., & Ikauniece, A. (2023). Seasonal variation in size structure and production of autotrophic plankton community in eutrophied, low-light environment: A focus on Mesodinium rubrum. Oceanologia, 65(2), 398-409.	C		
2024	Morán X.A.G., Calleja M.Ll., Baltar F., Silva L., Ansari M.I., Carrillo de Albornoz P., Duarte C.M., Lønborg C. 2024. Substrate availability may limit the response of tropical bacterioplankton biomass to warming. Limnology and Oceanography 69: 2043-2056. DOI 10.1002/lno.12647	C		
2024	Heneghan R.F., Holloway-Brown J., Gasol J.M., Herndl G.J., Morán X.A.G., Galbraith E.D. 2024. The global distribution and climate resilience of marine heterotrophic prokaryotes. Nature Communications 15: 6943. DOI 10.1038/s41467-024-50635-z	C		
2023	Labban A., Shibl A.A., Calleja M.Ll., Hong P.-Y., Morán X.A.G. 2023. Growth dynamics and transcriptional responses of a Red Sea Prochlorococcus strain to varying -temperatures. Environmental Microbiology 25: 1007-1021. DOI 10.1111/1462-2920.16326	C	A	G

2023	Morán X.A.G., Arandia-Gorostidi N., Huete-Stauffer T.M., Alonso-Sáez L. 2023. Temperature enhances the functional diversity of dissolved organic matter utilization by coastal marine bacteria. Environmental Microbiology Reports 15: 31-37. DOI 10.1111/1758-2229.13123	C	B	
2022	Lønborg C., Baltar F., Calleja M.L., Morán X.A.G. 2022. Heterotrophic bacteria respond differently to increasing temperature and dissolved organic carbon sources in two tropical coastal systems. Journal of Geophysical Research: Biogeosciences 127: e2022JG006890. DOI 10.1029/2022JG006890	C		
2021	Labban A., Palacio A.S., García F.C., Hadaidi G., Ansari M.I., López-Urrutia Á., Alonso-Sáez L., Hong P.-Y., Morán X.A.G. 2021. Temperature responses of heterotrophic bacteria in co-culture with a Red Sea Synechococcus strain. Frontiers in Microbiology 12: 612732. DOI 10.3389/fmicb.2021.612732	C		
2021	Morán X.A.G. 2021. Heterotrophic bacterioplankton responses in coral- and algae-dominated Red Sea reefs show they might benefit from future regime shift. Science of the Total Environment 751: 141628. DOI 10.1016/j.scitotenv.2020.141628	C		
	ICES (2021). Celtic Seas Ecoregion – Ecosystem overview. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, Section 7.1, https://doi.org/10.17895/ices.advice.9432	C		
	ICES (2023). Theme Session F – Integration of molecular tools for biodiversity, risk assessment, ecosystem advice within a changing climate. ASC 2023 - Theme session F. Conference contribution. https://doi.org/10.17895/ices.pub.24420700.v1	C		
2024	Catlett, D., E.E. Peacock, D.N. Fontaine, E.T. Crockford, M.J. McKenzie, T.A. Rynearson, and H. M. Sosik. 2024. Concurrent DNA meta-barcoding and plankton imaging reveals novel parasitic infection and competition in a diatom. Limnology and Oceanography. https://doi.org/10.1002/lno.12629	C		

2024	Castillo Cieza, S. A., R. H. R. Stanley, P. Marrec, D. N. Fontaine, E. T. Crockford, D. J. McGillicuddy Jr., A. Mehta, S. Menden-Deuer, E. E. Peacock, T. A. Rynearson, Z. O. Sandwith, W. Zhang, and H. M. Sosik. 2024. Unusual Hemiaulus bloom influences ocean productivity in Northeastern US Shelf waters. Biogeosciences. 21: 1235–1257. https://doi.org/10.5194/bg-21-1235-2024	C		
2024	Stevens, B.L.F., E.E. Peacock, E.T. Crockford, M.G. Neubert, and H.M. Sosik. 2024. Distinct responses to warming within picoplankton communities across an environmental gradient. Global Change Biology 30: 17316. https://doi.org/10.1111/gcb.17316	C		
2024	Kramer, S.J, L.M. Bolaños, D. Catlett, A.P. Chase, M.J. Behrenfeld, E.S. Boss, E.T. Crockford, S.J. Giovannoni, J.R. Graff, N. Haëntjens, L. Karp-Boss, E.E. Peacock, C.S. Roesler, H.M. Sosik, and D.A. Siegel. 2024. Toward a synthesis of phytoplankton community composition methods for global-scale application. Limnology and Oceanography: Methods. 22: 217-240. https://doi.org/10.1002/lom3.10602	C	E	
2023	Tapics, T., H. M. Sosik, and Y. Huot. 2023. A discrete, stochastic model of colonial phytoplankton population size structure: Development and application to in situ imaging-in-flow cytometer observations of Dinobryon. Journal of Phycology. https://doi.org/10.1111/jpy.13357	C		
2023	Catlett, D., E. E. Peacock, E. T. Crockford, J. Futrelle, Batchelder, S., B. L. F. Stevens, R. Gast, W. G. Zhang, and H. M. Sosik. 2023. Temperature dependence of parasitoid infection and abundance of a diatom revealed by automated imaging and classification. Proceedings of the National Academy of Sciences of the United States of America.120: e2303356120. https://doi.org/10.1073/pnas.2303356120	C		
2023	Stevens, B.L.F., E. T. Crockford, E. E. Peacock, M. G. Neubert, and H. M. Sosik. 2023. Temperature regulates Synechococcus population dynamics seasonally and across the continental shelf. Limnology and Oceanography: Letters. https://doi.org/10.1002/lol2.10331	C		

2023	Galaz-García, C., K.J. Bagstad, J. Brun, R. Chaplin-Kramer, T. Dhu, N. J. Murray, C. J. Nolan, T. H. Ricketts, H.M. Sosik, D. Sousa, G. Willard, and B. S. Halpern. 2023. The future of ecosystem assessments is automation, collaboration, and artificial intelligence. Environmental Research Letters 18: 011003. https://doi.org/10.1088/1748-9326/acab19	C	B	
2022	Ducklow, H., M. Cimino, K.O. Dunton, W. Fraser, R. Hopcroft, R. Ji, A. Miller, M.D. Ohman, and H.M. Sosik. 2022. Marine coastal pelagic ecosystem responses to climate variability and change. BioScience. 72: 827-850. https://doi.org/10.1093/biosci/biac050	C		
2021	Hunter-Cevera, K.R., B.R. Hamilton, M.G. Neubert and H.M. Sosik. 2021. Seasonal environmental variability drives microdiversity within a coastal Synechococcus population. Environmental Microbiology. 23(8), 4689–4705. https://doi.org/10.1111/1462-2920.15666	C		
2021	Oliver, H., W.G. Zhang, W.O. Smith, P. Alatalo, P.D. Chappell, A. Hirzel, C.R. Selden, H.M. Sosik, R.H.R. Stanley, Y. Zhu, and D.J. McGillicuddy, Jr. 2021. Diatom hotspots driven by western boundary current instability. Geophysical Research Letters. 48(11), e2020GL091943, https://doi.org/10.1029/2020GL091943	C		
2021	Smith, W.O., Zhang, W.G., Hirzel, A., Stanley, R.H.R., Meyer, M., Sosik, H.M., Alatalo, P., Oliver, H., Sandwith, Z., Crockford, T., Peacock, E., Mehta, A., and McGillicuddy, D.J. 2021. A regional, early spring bloom of Phaeocystis pouchetii on the New England continental shelf. Journal of Geophysical Research: Oceans, 126(2), 2020JC016856. https://doi.org/10.1029/2020JC016856	C		
2024	de la Iglesia-Vélez, B., Díaz-Pérez, L., Luis Acuña, J., Morán, X.A.G. (2024) Spatial and seasonal variability of picoplankton abundance and growth rates in the southern Bay of Biscay. Marine Environmental Research, 194:106331. doi.org/10.1016/j.marenvres.2023.106331	C		

2023	Leontidou, K., Abad Recio, I., Rubel, V., Filker, S., Däumer, M., Thielen, A., Lanzén, A., Stoeck, T. (2023). Simultaneous analysis of seven 16S rRNA hypervariable gene regions increases efficiency in marine bacterial diversity detection. Environmental Microbiology. 25. 10.1111/1462-2920.16530.	D		
2023	Eriksen, Elena, Dmitry Prozorkevich, Stine Karlson, Sarah Lerch, Tatiana Prokhorova, Berengere Husson, Andrey Dolgov, and Georg Skaret. 2023. "Survey report (Part 1) from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and the adjacent waters August-October 2023<IMR-PINRO_2024_02.pdf>." In.	E		
2023	Setta, S. P., S. Lerch, B. D. Jenkins, S. T. Dyhrman, and T. A. Rynearson. 2023. 'Oligotrophic waters of the Northwest Atlantic support taxonomically diverse diatom communities that are distinct from coastal waters', J Phycol.	E	C	
2023	Jerney, J., Hällfors, H., Jakobsen, H.H., Jurgensone, I., Karlson, B., Kremp, A., Lehtinen, S., Majaneva, M., Meissner, K., Norros, V.S., Sildever, S., S., S. and Teeveer, K. 2023 DNA metabarcoding for monitoring the diversity and distribution of phytoplankton in marine and brackish water, p. 68, Nordic Council of Ministers, Copenhagen.	E		
2021	Haraguchi, L., Moestrup, O., Jakobsen, H.H. and Lundholm, N. 2022. Phytoflagellate diversity in Roskilde Fjord (Denmark), including the description of Pyramimonas octopora sp. nov(Pyramimonadales, Chlorophyta). Phycologia 61(1), 45-59.	E	F	
2022	Jerney,J.,Hällfors,H.,Oja,J.,Reunamo,A.,Suikkanen,S.,Lehtinen,S. 2022 Guidelines for using environmental DNA in Finnish marine phytoplankton monitoring. Improved biodiversity assessment through method complementation. Reports of the Finnish Environment Institute 40, 2022.	E		
2024	Abad Recio, Ion & Alonso-Sáez, Laura & Lanzén, Anders. (2024). Toward functional profiling for eDNA-based monitoring in coastal environments: A comparison of three approaches. Environmental DNA. 6. 10.1002/edn3.504.	E	A	B

2024	O'Brien, T.D., Blanco-Bercial, L., Questel, J.M., Batta-Lona, P., Bucklin, A. 2024. MetaZooGene Atlas and Database: Reference Sequences for Marine Ecosystems. DNA Barcoding Methods in Molecular Biology. doi.org/10.1007/978-1-0716-3581-0_28	E		
2021	Käse L, Metfies K, Neuhaus S, Boersma M, Wiltshire KH, Kraberg AC (2021) Host-parasitoid associations in marine planktonic time-series: Can metabarcoding help reveal them? PLoS ONE 16(1): e0244817. https://doi.org/10.1371/journal.pone.0244817	F		
2022	Godinho, L., Soliño, L., Churro, C., Timoteo, V., Santos, C., Gouveia, N., … Reis Costa, P. (2022). Distribution, identification and cytotoxicity of Gambierdiscus (Dinophyceae) in the Atlantic Selvagens Islands (Madeira, Portugal): a ciguatera gateway to Europe. European Journal of Phycology, 58(2), 156–168. https://doi.org/10.1080/09670262.2022.2086710	F		
2023	Costa, P.R.; Churro, C.; Rodrigues, S.M.; Frazão, B.; Barbosa, M.; Godinho, L.; Soliño, L.; Timóteo, V.; Gouveia, N. A 15-Year Retrospective Review of Ciguatera in the Madeira Islands (North-East Atlantic, Portugal). Toxins 2023, 15, 630. https://doi.org/10.3390/toxins15110630	F		
2023	Implementation of na official monitoring HAB program in Madeira Island 2023 to present	F		
2022	Barbosa, M., Castro, D., Churro, C., Giraldez, J., Frazão, B., Timóteo, V., Gouveia, N., Leão, J. M., Amorim, A., Gago-Martínez, A., & Costa, P. R. (2024). Gambierdiscus from Madeira Island (Portugal): Growth, ecology, and toxins. Oral presentation at RIMATyB 2024 - XV Reunión Ibérica sobre MicroAlgas Tóxicas y Biotoxinas, Canary Islands, 5 June 2024	F		
2022	REDIBAL- XIV Iberian Meeting on Harmful Microalgae and Marine Biotoxins	F		
2024	Taylor, D., Jakobsen, H., Lyngsgaard, M.M., Darecki, M., Werther, M., Maar, M. and Saurel, C. 2024. Quantifying bivalve phytoplankton depletion in a eutrophic system: an integrated approach. Limnology and Oceanography 69(10), 2436-2452.	F		

2023	Carstensen, J. and Jakobsen, H.H. 2023 Harmful algae in the Limfjorden: a data reviwe. Ecoscience, D.f. (ed), p. 59, Aarhus Universitet, – Nationalt Center for Fødevarer og Jordbrug, Aarhus. https://pure.au.dk/ws/portalfiles/portal/304792157/Harmful_algae_in_Limfjorden_a_desktop_study_230125.pdf	F		
2023	Chevrollier, L.A., Cook, J.M., Halbach, L., Jakobsen, H., Benning, L.G., Anesio, A.M. and Tranter, M. 2023. Light absorption and albedo reduction by pigmented microalgae on snow and ice. Journal of Glaciology 69(274), 333-341.	F		