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ICES-IOC Working Group on Harmful Algal Bloom Dynamics Summary Activity Report 2023-2025

IPHAB XVII Meeting, Paris 18th -20th March 2025

Dave Clarke, Marine Institute, Ireland

Lars Johan Naustvoll, Institute of Marine Research, Norway

Background - The ICES-IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD) was established in 1994 on the basis of a Study Group on the Dynamics of Algal Blooms created two years earlier.

Objectives - WGHABD is an important forum for ICES and IOC-UNESCO to review and discuss HAB events and to provide annual advice and updates on the state of HABs in the region.

The aim of the working group is to outline the various physical, chemical and biological interactions associated with harmful algal blooms (HAB) and to define the main gaps in research.

Through this established forum, we identify and discuss the various approaches and challenges to HAB research and monitoring.



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ICES-IOC WGHABD chairs (2024 – 2026)

- Dave Clarke (Ireland)
- Lars Johan Naustvoll (Norway)

ICES Website Homepage

<https://www.ices.dk/community/groups/pages/wghabd.aspx>

IOC UNESCO Website Homepage

<https://hab.ioc-unesco.org/ices-ioc-working-group-on-harmful-algal-bloom-dynamics-wghabd/>



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Expertise - Our WG expert group members cover multiple areas of HAB science, monitoring and research including oceanographic, biological, ecological, molecular and modelling processes which all influence the dynamics of HABs and their subsequent impacts on marine ecosystems.

Research

- Collect information about harmful algal events in the ICES area. This information is stored in a joint IOC-ICES-PICES database, HAEDAT, which is a part of the IOC International Ocean Data exchange (IODE).
- Deliver and discuss annual National reports and new findings on HAB events and bloom dynamics.
- Early Warning Systems for HAB forecasting
- Frequency of HAB distribution and impacts on plankton communities in a changing climate
- Produce protocols and guidelines for qPCR methodologies for the study and monitoring of HAB species using eDNA.

There are 8 (a – h) ToR’s for the 2024-2026 Cycle

ToR	Descriptor & Background
ToR (a)	<p>Deliver National Reports on harmful algal events and bloom dynamics for the years 2023, 2024 and 2025</p> <p>HAB events may affect human activities and marine ecosystems at different levels. Understanding can best be achieved by integrating multiyear data sets. This links to ICES Science Priorities Ecosystem Science, Seafood Production, Conservation and Management Science.</p>

ToR	Descriptor & Background
ToR (b)	<p>Identify and access the interactions of HAB dynamics with multidimensional environmental stressors on marine faunal mortalities and morbidity</p> <p>Marine mortalities are a common factor linked to HAB events within the ICES region and thereby collectively reported within HAEDAT under ToR (c). Unfortunately, combining mass mortalities invariably associated with high biomass blooms (either toxigenic or not), tends to obscure the distinction of mechanisms of action causing mortalities. Within this ToR, fish-killing algal blooms will be considered in the functional content of caged-fish aquaculture, wild fish populations and other collateral damage to marine fauna and coastal ecosystems. Particular focus will be directed on defining the specific mode of action of dynamic ichthyotoxic blooms on salmonid aquaculture, the major fish aquaculture group impacting socioeconomic interests in the ICES region. Evidence that multifactorial environmental stressors, plausibly linked to climate change and/or anthropogenic factors, can amplify and attenuate the effects of HABs on fish mortalities and health status.</p>

ToR	Descriptor & Background
ToR (c)	<p>The ICES-PICES-IOC harmful algal event database (HAEDAT) will be updated by delegates on an annual basis.</p>
	<p>The ICES-PICES-IOC database plays a key role in the production of the first ICES Harmful Algal Event Status Report and remains an important source information about the global distribution of Harmful Algal Events. This will continue to be updated so that the ICES area can contribute to future HAB reporting initiatives such as updates to the IOC Global HAB Status Report, OSPAR assessments and more. This ToR links to Science Priorities Ecosystem Science, Seafood Production, Conservation and Management Science as well as contributing to the ‘Safe Ocean’ objectives of the UN Decade for Ocean Science for Sustainable Development</p>
ToR	Descriptor & Background
ToR (d)	<p>HABs: Mitigation and Bloom Control</p>
	<p>Progressive climate-driven changes over the next decades are expected to increase demand on wild fisheries and aquaculture-based food supplies to maintain food security. The pressures on coastal systems also continue to increase with the expansion of coastal communities and tourism. Both of these needs are threatened in many regions of the world by increasingly problematic HABs. Moreover, the increasing reliance on aquaculture as a food resource is in contrast to a decrease in the willingness for insurers to provide coverage for the aquaculture industry as aggregate HAB-related losses drive them from the marketplace. There is thus an escalating industry and societal desire to have safe and effective bloom control options that can minimize or prevent HAB problems. Despite great advances in our understanding of HAB dynamics and our ability to detect and quantify HABs and their toxins, however, there are only a few successful examples where HAB control approaches have been implemented on a significant scale in natural marine waters. Part of this disconnect between needs and solutions stems from concerns by the public, the HAB research and management community, and diverse marine stakeholders over the balance between the benefits and unintended environmental consequences. However, the societal, economic, geographic, and environmental impacts from marine HABs have increased in many areas over the last 30 years, as has the demand for acceptable, effective, and scalable HAB control approaches.</p>

ToR	Descriptor & Background
ToR (e)	<p>Report on new findings in the area of harmful algal bloom dynamics</p>
	<p>The dynamics and impacts of HABs and the technologies to monitoring them are evolving rapidly. WG members report new findings on the topic of algal bloom dynamics in the ICES area. This ToR feeds into ICES Science Priorities Ecosystem science, Emerging Technologies and Techniques, Observation and Exploration.</p>

ToR	Descriptor & Background
ToR (f)	<p>Early Warning Systems: for HAB forecasting</p>
	<p>Early warnings of HABs are important for society, e.g. for the aquaculture industry, tourism, and desalination plants. A combination of early detection of HAB organisms with models forecasting growth and advection of HABs are already in operation or in development in some ICES countries. Novel methods for observations combined with high resolution physical oceanographic models and AI-based forecasting are in development or pre-operational.</p>

ToR	Descriptor & Background
ToR (g)	<p>HAB distribution and frequency in a changing climate</p> <p>Plankton are sensitive indicators of short- and long-term change, and as such, are classed as an Essential Ocean / Climate Variable (EOV, ECV). Climate change consequences stemming (but not limiting) from elevated seawater temperatures, changes in pH, salinity, nutrients and weather patterns (such as winter storms) are expected to influence plankton dynamics. There is also the potential for changes in planktonic diversity due the threat of the occurrence of non-native/invasive species. This ToR will investigate and review case studies on present and potential future changes of phytoplankton abundance, diversity, and distribution in the ICES NE Atlantic Arc region with respect to climate change.</p>

ToR	Descriptor & Background
ToR (h)	<p>Produce protocols and guidelines for qPCR methodologies for the study and monitoring of HAB species using eDNA</p> <p>The use of environmental DNA approaches are becoming routine for microbial community and species distribution studies. Work undertaken in the previous two reporting cycles have lead WGHABD to identify the qPCR method based on eDNA as the most appropriate method for HAB species ecological studies and monitoring. WGHABD have taken a longer term view here with this ToR and see it lasting two reporting cycles. The final outcome will be agreement on common protocols and assays and on the potential of applying of qPCR in routine HAB monitoring. This has direct relvance to ICES Science priorities Ecosystem Science and Emerging Techniques and Technologies.</p>

Year 1 Work Plan Summary

- Present national reports, new findings and update HAEDAT database with regional HAB events on annual basis. Review HAEDAT reporting forms and report to IOC with recommendations.
- Collate and present information on identifying the interactions of HAB dynamics with environmental co-stressors on observed/reported mortalities – particularly fish caged aquaculture.
- Production of guidelines and protocols for the ICES area for qPCR methods.
- Collate regional/country timeseries data on phytoplankton diversity and abundance.
- An overview of existing HAB early warning systems in the ICES region is compiled.
- Review and report on global progress on HAB control/bloom mitigation

Year 2 Work Plan Summary

- Present national reports, new findings and update HAEDAT database with regional HAB events on annual basis. Review products from HAEDAT and presentation at ICHA conference in 2025.
- Discussion and feedback from the monitoring systems about the feasibility of the application of the qPCR protocols.
- Define the specific mode of action of dynamic ichthyotoxic blooms on salmonid aquaculture, the major fish aquaculture group impacting socioeconomic interests in the ICES region.
- Examine current and potential application of in-situ remote sensing platforms for HAB species detection and their accuracy when compare.
- Examine trend data for HAB causative dinoflagellate species.
- Review and report on global progress on HAB control/bloom mitigation.
- Focus topics: 1.How do we move from “nowcasts” to “forecasts” 2.Challenges of obtaining/incorporating industry data 3.Automated systems vs microscopy

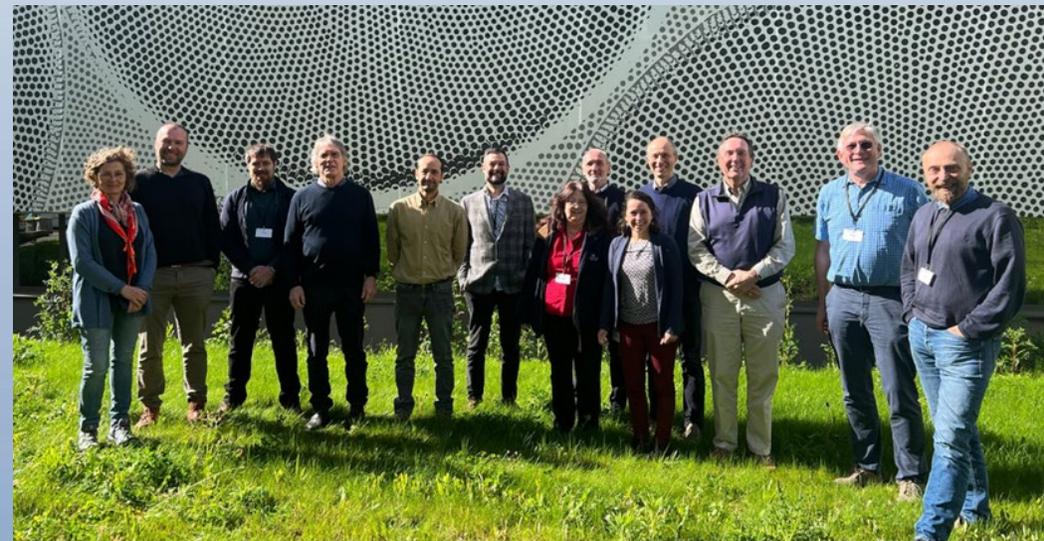
Year 3 Work Plan Summary

- Present national reports, new findings and update HAEDAT database with regional HAB events on annual basis
- Organisation of a practical qPCR workshop to demonstrate the selected and validated protocols.
- Present evidence that multifactorial environmental stressors, plausibly linked to climate change and/or anthropogenic factors, can amplify and attenuate the effects of HABs on fish mortalities and health status.
- Examine trend data for other HAB species with the deliverable: Summary overview document with potential case studies.
- Review and report on global progress on HAB control/bloom mitigation.
- Automated systems vs microscopy - Focus topic: The potential for AI in supporting early warning systems.
Deliverable in the form of a manuscript submitted to a scientific journal.

ICES-IOC WGHABD Annual Meeting, 16th – 18th Apr 2024 – Nantes, France

In 2024, the joint ICES-IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD) held its annual meeting at the French Research Institute for Exploitation of the Sea (IFREMER), Nantes, France, both in-person and remote access format, from 16th to 18th April 2024, where a combined total of 35 participants attended over the three days. For the new three-year cycle (2024-2026).

This meeting and its participants focused its discussions, presentations and progress which are directly linked to the previously agreed current cycle's Terms of Reference (ToR) descriptors which detail the ToR descriptor background, its expected duration, and expected Year 1 deliverables as detailed and approved in the ICES document WGHABD Terms of Resolutions 2024-2026 (page 11) and also in accordance with the described Year 1 summary of the identified work plan



There was a number of additional presentations from chair invited guests to this meeting which covered a range of relevant topic areas to the Working Group including *Lingulaulax polyedra* blooms along the French Atlantic coast; update on Remote sensing tools and applications; new tools for investigating relationships between HAB and mixotrophy; AI for HABs, an early warning system; and updates from our joint co-sponsor IOC-UNESCO on Toxins database; HAB-Solutions (UN Decade of Ocean Science approved project) and update on GlobalHAB Scientific Steering Committee activities and outputs. New funded project on *Ostreopsis* – *Ostreabilla* was also presented.

ICES Annual Science Conference 2023, 11–14 September 2023, Bilbao, Spain
- Theme Session F

Integration of molecular tools for biodiversity, risk assessment, ecosystem advice within a changing climate

Conveners: Dave Clarke (Ireland), Cynthia McKenzie (Canada) , Rowena Stern (UK)

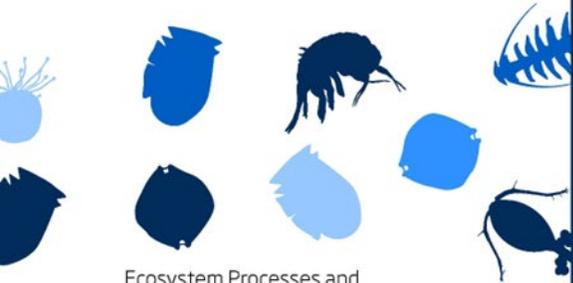
This theme session provides an opportunity to discuss the current molecular tools available and the approaches which have been implemented in assessing biological case studies. Topics include challenges facing the routine implementation of these molecular tools alongside current methods in regulatory and long-term monitoring programmes, and exploring the best tools to contribute to specific policy and marine management decisions.

Theme session F attracted 90 people attending in person with 44 people attending online – 13 oral & 13 poster presentations



WGHABD

Working Group on Harmful
Algal Bloom Dynamics



Ecosystem Processes and
Dynamics Steering Group (EPDSG)

RESEARCH FOCUS

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OUR OBJECTIVE

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OUR EXPERTISE

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OUR CHAIRS



Dave Clarke



Lars Johan
Naustvoll

2024 ICES Annual Science Conference ICES – IOC WGHABD Poster

2024 ICES Annual Science Conference (ASC) in Gateshead (9–12 September 2024).

There was a special poster session for all Working Groups for each Steering Group, to exhibit their activities, objectives, expertise and research focus.

Cynthia McKenzie (Canada) presented the ICES-IOC WGHABD poster.

These posters are available for each of the WG homepages on the ICES website

[https://www.ices.dk/community/groups/Documents/EG%20posters/WGHABD%20\(EPDSG\)%20Poster.pdf](https://www.ices.dk/community/groups/Documents/EG%20posters/WGHABD%20(EPDSG)%20Poster.pdf)



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From climate to microorganisms and fish: What can long-term time series tell us?

Conveners: Dafne Eerkens-Medrano (UK), Frédéric Cyr (Canada), Lidia Yebra (Spain), Dave Clarke (Ireland)

Long-term time series greatly assist with monitoring and assessing the environmental and species diversity responses, and their changes within ecosystems to environmental and climate change impacts. This theme session provides a platform to present and stimulate discussions on the importance and relevance of long term series across three key topic areas, and how these can be standardised and improved for informed policy direction and ecosystem management for the future of the oceans.



Will explore how decades of consistent observation help untangle the natural and human-driven changes affecting marine ecosystems. Ecosystem trends and what they reveal, new methods using AI and eDNA, and enhancing knowledge transfer to policy-makers for better management - the power of long-term data in understanding climate change, ecosystem shifts, and evaluating management effectiveness will be highlighted.

Additional WGHABD group summary outputs for 2023 – 2025 period include:

- Current collaborative work with WG PME (Phytoplankton and Microbial Ecology) group on ‘ICES Cooperative Research Report on phytoplankton and microbial trends in the North Atlantic: an update from 2012-2022’.
- Actively participate in ICES WG meetings (i.e. WGCHAIRS) and with EPDSG (Ecosystem Process Dynamics Steering Group)
- ICHA 2023 workshop on HAEDAT & HAIS – ‘The Power of Big Data for HAB Risk assessment and predicting HAB futures’
- In preparation - ICES Cooperative Research Report on HAEDAT metadata and ICES Scientific Report on WGHABD 2021-2023
- Articles for Harmful Algal News
- In 2023 qPCR workshop on molecular methods for HABs
- Upcoming annual WGHABD Meeting at Swedish Meteorological & Hydrological Institute (SMHI), Gothenburg, Sweden 8th – 10th April 2025



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