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Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT)

2022/FT/EPDSG02 The Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT), chaired by Dafne Eerkes-Medrano*, UK and Aitor Albaina*, Spain, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2023	31 March	Naples, Italy	Interim e-evaluation	hybrid, change in chairs
Year 2024	Jan/Feb	Plymouth, UK	Interim e-evaluation	hybrid
Year 2025	March	tbc	Final report to SCICOM	

ToR descriptors¹

ToR	Description	Background	Science Plan Codes	Duration	Expected Deliverables
a	Evaluate the potential of integrated approaches for understanding plankton communities	Molecular methods are widely used for rapid assessment of species diversity, and can contribute to improving our understanding of the impacts of climate change and anthropogenic effects on marine ecosystems. There is a need for inter-comparison of results to understand the impact of using different genetic markers that will allow a broader taxonomic coverage and are complementary.	1.6; 1.7; 4.4	3 years	<ol style="list-style-type: none"> 1. A report which identifies the limitations of different methods and genetic markers for zooplankton taxa (year 3) 2. A review which examines studies in pelagic ecology that effectively use integrative methods - (year 3)

¹ Avoid generic terms such as “Discuss” or “Consider”. Aim at drafting specific and clear ToR, the delivery of which can be assessed

b	Demonstrate the advantages of using integrated methods in long-term monitoring of plankton communities	The use of integrative methods offers complementarity and a broader assessment of zooplankton diversity and community structure. Morphology alone cannot cover the whole diversity spectrum and has its known limitations (e.g. laborious, challenge for cryptic species or partial specimens). Nonetheless it offers other essential levels of detail that complement and confirm taxonomic assessments derived from optical or molecular approaches. Metabarcoding as well as eDNA metabarcoding has been used effectively for marine biodiversity assessments and more so often for bio-monitoring purposes. Particular advantages of metabarcoding techniques are being relatively cheap and quick in obtaining results, with eDNA metabarcoding furthermore also being non-invasive.	1.6; 1.7; 4.4	3 years	<ol style="list-style-type: none"> 1. A list of invasive species that are detected within zooplankton communities by using integrated methods (year 2) 2. A report which compares data generated using current classical time-series monitoring vs. information from metabarcoding with a specific focus on meroplankton (year 3)
c	Initiate and support provision of standards, training materials, taxonomy workshops and data resources in collaboration with other WGs	The WGIMT Resource Portal provides informational overviews and links to relevant literature and web pages, with a special focus on the use of molecular technologies (and morphological verification) for the integrative taxonomy of zooplankton. Taxonomy workshops are effective in engaging target audiences and ensuring trained technicians and researchers for applications in fisheries and ecosystem management. Co-sponsored workshops and meetings with other EGs will increase impact and likelihood of adoption of integrated methods for advisory applications.	1.6; 1.8	3 years	<ol style="list-style-type: none"> 1. Expansion of the WGIMT North Atlantic barcoding Atlas (in collaboration with WGPME) (year 3) 2. Ensure provision of training materials (year 1-3) 3. Design and organize integrative taxonomy workshops (year 1-3) 4. Continue development and enhancement of the WGIMT Resource Portal (year 1-3)

d	<p>Continue to demonstrate leadership in promoting and encouraging use of integrative taxonomic approaches for assessment of marine pelagic biodiversity</p> <p>Integrative taxonomy is a developing field; uses and applications for fisheries and ecosystem management should be explained in high-visibility settings in ICES and other organisations through special sessions at scientific conferences. It is important to maintain a strong foundation and visibility in primary research literature in order to validate metagenetic approaches for analysis of zooplankton diversity. Publication in peer-reviewed scientific journals will demonstrate validity of data, protocols, and results, and allow dissemination and new applications in ecosystem management.</p>	1.6; 1.7; 1.8	3 years	<ol style="list-style-type: none"> 1. Organize & promote special sessions at national and international conferences: e.g. ICES ASC; ASLO/TOS Ocean Sciences Meetings, Zooplankton Production Symposium (year 1-3) 2. Publish peer-reviewed scientific papers on topics central to the WGIMT mission, including papers on population connectivity and phylogeography of key species in different ecosystems and the integration of metabarcoding in time-series analysis (year 1-3)
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Summary of the Work Plan

Year 1	<p>Progress and reporting on all ToRs. Identification of limitations of different molecular methods and genetic markers for zooplankton taxa. Assembling list of invasive species that are detected within zooplankton communities by using integrated methods (ToRs a, b)</p>
Year 2	<p>Progress and reporting on all ToRs. Update of WGIMT barcode atlas and database in collaboration with WGPME. Carry out collaborative activities with other SCICOM EGs to promote integrative taxonomy and publish peer reviewed scientific articles on topics central to the WGIMT mission (ToRs c, d).</p>
Year 3	<p>Progress and reporting on all ToRs. Recommend, encourage, and enable use of integrated morphological and molecular taxonomic analysis of zooplankton in integrated ecosystem assessments in ICES area seas. Complete a review which examines complementary studies in pelagic ecology that effectively use integrative methods (ToRs a, b, c, d).</p>

Supporting information

Priority	The activities of WGIMT will assist ICES and its expert groups with issues related to the development, dissemination and application of taxonomic knowledge and skills in support of Integrated Ecosystem Understanding. Accurate identification of species and characterization of species-level diversity are and will remain foundations of integrated ecosystem assessments of function and state. Integrated taxonomic approaches – including morphological, molecular, optical, and other – may enhance and accelerate progress toward rapid, automatable, and near real-time identification of species for fisheries and integrated ecosystem assessments; detecting the impacts of climate change on species diversity, distribution, abundance; and understanding alterations in food web structure and function, and associated biogeochemical cycles. The availability of and need for new technology and techniques in taxonomic analysis make WGIMT's goals and activities important and high priority
Resource requirements	Participation in annual meetings will in the future be challenged due to the changes in working conditions since the COVID-19 pandemic and funding. Hybrid meetings will be the preferred meeting format and technical support by the ICES Secretariat might be requested
Participants	This Expert Group now includes 63 members from 20 countries, and has a balanced representation among experts in morphological and molecular taxonomic approaches covering a good range of taxonomic groups and ICES geographic regions. The group's annual meeting had to move to online meetings in 2020-2022 due to the pandemic situation and was attended by 22-27 members. New members are welcome and early career researchers are encouraged to participate. In the upcoming year, WGIMT will actively seek to include early career scientists by providing the opportunity to introduce their research during the annual meeting
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	WGIMT arose as a Study Group from the WGZE in response to perceived need, meeting in association with WGZE during 2012 and 2013. WGIMT will remain in close partnership with WGZE, WGPME, and WGEUROBUS, as well as SCOR WG 157, while promoting and supporting integrated morphological and molecular taxonomy science for the benefit of the ICES science and advisory communities as a whole. Outcomes of the work will also address topics related to e.g., WGITMO (HAPISG)
Linkages to other organizations	The work of this group relates to and is connected to a diversity of other projects and organisations, e.g. SCOR WG157 MetaZooGene, BONUS BIO-C3 project, NOAA COPEPOD and COPEPODITE, GOBI, and others.

Working Group on Cephalopod Biology and Life History (WGCEPH)

2022/FT/EPDSG03 The **Working Group on Cephalopod Fisheries and Life History (WGCEPH)**, chaired by i) Daniel Oesterwind, Germany, ii) Catalina Perales-Raya, Spain*, iii) Vladimir V. Laptikhovskiy*, UK will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2023	June 2023 (dates tbc)	Instituto de Investigaciones Marinas, Vigo, Spain	Interim e-evaluation	Change in chairs: Outgoing: Ana Moreno (Portugal) and Graham Pierce (Spain) Incoming: Catalina Perales-Raya (Spain) and Vladimir V. Laptikhovskiy (UK)
Year 2024	tbc	tbc	Interim e-evaluation	
Year 2025	tbc	tbc	Final report by Date Month to EPDSG	

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Report on cephalopod stock status including fishery and survey trends: update, quality check and analyse relevant data (landings, directed effort, discards and survey catches).	Our aim is to provide an overview of the current status of fishery-relevant cephalopod stocks in the ICES areas, along with trends in abundance/biomass derived from various surveys.	5.1, 5.2, 6.1	3 years	Cephalopod stock status reports (Annual)

b	Review new and existing assessment methods for use with cephalopod fisheries and within the MSFD. Test and adapt (if available) these methods for use with cephalopod fisheries and within the Marine Strategy Framework Directive (MSFD), using data of European cephalopods (e.g. EU-Data Collection Framework, ICES coordinated fishery surveys).	Cephalopods are important ecosystem components but in the European large-scale fishery, fishing is essentially unregulated and a routine assessment does not exist for most species. Furthermore, most Member States have not included cephalopods within their MSFD status report. Both illustrate the current gap in management and assessment. The goal is advancing the assessment of European cephalopods	5.1, 5.2, 6.1	3 years	Report on advances in cephalopod stock assessment (Annual)
c	Review/update advances in knowledge of life history and ecology, identifying research priorities with the focus on cephalopod assessment methods and relevant information, including the availability of necessary data within European waters.	Cephalopods show short life-cycles as well as high variation individual life history and population abundance; understanding this variation is essential to underpin assessment and management.	1.7, 5.2	3 years	Report on relevant new knowledge and research priorities of cephalopod life-history and ecology (Y3)
d	Update best practice for routine biological data collection	It is recognized that the current standard data collection is insufficient to understand population dynamics, and to support fishery characterization and routine assessment. The sampling strategy needs to be optimized and the sampling intensity adapted to meet the needs, considering the time and budget constraints.	1.7, 3.2, 5.2	3 years	Review of biological sampling data from European programs, and identification of shortcomings (Y2). Analysis and guidelines of best practices for sampling strategy optimization (Y2); Updated data collection recommendations (Y3)

e	Review, develop and recommend tools for cephalopod species identification (ID) including image data collection.	Cephalopod species identification in fishery and survey catches remains inconsistent and incomplete. To improve species identification, simple guides need to be developed in all regions for 'easy to use' by fishers, fishery officers, inspectors, buyers, and scientists undertaking sampling. Since there is an existing effort to collect images for the regional identification guides, we could build on this effort to develop an image library that could be used to train and improve the accuracy of Artificial Intelligence and Machine Learning (AI/ML) Apps.	1.6, 3.2, 5.2	3 years	List of new/revised scientific ID guides (Annual); Simple regional ID guides for fishers (Y1); Image data management (data and metadata standards, archiving, access, dissemination) recommendations (Y2); Image data processing using AI/ML Apps recommendations (Y3).
f	Better understand the socio and economic dimensions, markets and value chains of cephalopod fisheries and explore the potential to foster transformative changes.	The European Union is one of the most important markets for cephalopod fisheries in the world. However, socioeconomic information, essential for effective management of these resources, is scarce. Plus, cephalopods value chains are global and more information is needed on markets and value chains of cephalopods.	5.8, 7.2	3 years	Paper on sustainability of the octopus value chain in the Algarve (Y1); Paper on protocol for integrated value chain analysis for cephalopod fisheries (Y2); Paper Falkland Islands Argentine shortfin squid ecopath (Y2); Octopus markets and seafood traceability (Y3).
g	Develop simple climate envelope models of cephalopod species, explore distribution shifts with climate change and long-term climate projections to aid fisheries management of cephalopods in a changing climate.	Despite high phenotypic plasticity, cephalopod distribution is limited by extremes of temperature, salinity, dissolved oxygen, etc. and it is reported that climate change has led, and will lead to, range shifts. The management community is looking for tools and decision support to manage fisheries in changing conditions and species distribution predictive modelling will be useful in this regard.	1.3, 1.5, 2.5	3 years	Paper on climate envelopes models and predicting range shifts for at least one cephalopod taxon (Y3)

Summary of the Work Plan

Year 1	Cephalopod stock status reports, including advances in stock assessment, Simple regional ID guides for fishers, Paper on sustainability of the octopus value chain in the Algarve
Year 2	Cephalopod stock status reports, including advances in stock assessment, Review of biological sampling data from European programs, and identification of shortcomings, Analysis and guidelines of best practices for sampling strategy optimization; Image data management (data and metadata standards, archiving, access, dissemination) recommendations, Paper on protocol for integrated value chain analysis for cephalopod fisheries, Paper Falkland Islands Argentine shortfin squid ecopath
Year 3	Cephalopod stock status reports, including advances in stock assessment, Report on relevant new knowledge and research priorities of cephalopod life-history and ecology, , Image data processing using AI/ML Apps recommendations, Octopus markets and seafood traceability, Paper on climate envelopes models and predicting range shifts for at least one cephalopod taxon

Supporting information

Priority	<p>The current activities of this Group will inform ICES about the status of cephalopod stocks and fisheries at a time when fishing pressure is increasing. Cephalopods are not covered by the EU Common Fisheries Policy but there is a need to identify sustainability issues and to be in a position to recommend management actions, should the need arise. Furthermore, the planned preliminary assessment of different stocks can support the MSFD reporting in several member countries. These activities are believed to have a very high priority.</p> <p>ToRs a-g are envisaged as standing ToRs. ToRs a and b are fundamental for the advancing of stock assessment of European cephalopods and will involve a Data Call. ToR a will also review stock definition, since past preliminary assessments have been based on arbitrary spatial units and there is a need to define more appropriate management units. ToR c provides a review of recent advances in knowledge of cephalopod biology and ecology; improved understanding of life history plasticity, ecological roles and the high year to year variation in abundance remains a priority. ToR d continues efforts to facilitate better routine data collection of cephalopods. ToR e provides new tools to improve species identification. ToR f aims to ensure that social and economic sustainability of cephalopod fisheries are better understood, a key requirement for integrated ecosystem assessment. ToR g addresses effects of ocean warming on cephalopod distribution.</p>
Resource requirements	As noted in several previous reports, participation in WGCEPH is limited by availability of funding, especially as many members and potential members are staff of institutions which have no access to “national funds” for attendance at ICES meetings. Although there are no specific resource requirements, funding to assist wider participation would be beneficial.
Participants	Meetings of the Group are normally attended by around 15 members and chair-invited, with wider participation via videoconferencing and e-mail.
Secretariat facilities	None.
Financial	No specific financial implications (but see “resource requirements”).
Linkages to ACOM and groups under ACOM	The results of WGCEPH are potentially relevant for advice in the case that formal assessment and management are introduced for any of these species. .

Linkages to other committees or groups	Possible links with ICES groups working on predators of cephalopod (e.g. WGBIE, WGCS, WGMME). WGCEPH would like to encourage improved data collection on cephalopods during trawl surveys. It will make available (e.g. to IBTSWG) detailed diagrams and protocols for identifying cephalopods and collecting biological parameters during the scientific surveys. WGCEPH will provide information to SCICOM and its satellite committees as required to respond to requests for advice/information from NEAFC and EC DG Fish.
Linkages to other organizations	WGCEPH maintains links with ongoing European and national research projects and with the Cephalopod International Advisory Council.

Working Group on Marine Mammal Ecology (WGMME)

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group.

2022/FT/EPDSG04 The Working Group on Marine Mammal Ecology (WGMME), chaired by Sophie Brasseur, The Netherlands, and Peter Evans, UK, will meet on 30 January - 2 February 2023 at the Swedish Museum of Natural history, Stockholm, to:

- a) Review and report on any new information on seal and cetacean population abundance, distribution, population/stock structure in the NE Atlantic (including North Sea and Baltic Sea), including information on rare or vagrant species of marine mammals in the area of interest and updating the seal database with abundance estimates and new data points;
- b) Review and report on any new information on seal and cetacean management frameworks (including indicators and targets for MSFD assessments) in the NE Atlantic (as defined above);
- c) Review and report on any new information on i) seal and cetacean and anthropogenic threats (including cumulative effects) to individual health and population status in the NE Atlantic (as defined above); and ii) identify gaps in our knowledge with regards to anthropogenic threats to Marine mammals in the NE Atlantic
- d) In collaboration with WGBYC, contribute to the [Roadmap for ICES PETS bycatch advice](#) by
 - i) reviewing selected aspects of marine mammal-fishery interactions and assembling data and qualitative information on marine mammals available from other sources not fully covered by WGBYC (incl. strandings, entanglement, interviews, research projects, national/local monitoring),
 - ii) reviewing available information on those marine mammal species and/or regional populations for which bycatch estimates from at-sea monitoring are lacking or poorly known, and iii) identify gaps in our knowledge and provide guidance on prioritization of marine mammal species of bycatch concern.
- e) Review the main results from WGJCDP and WGMPAS with focus on developing relevant data products (WGJCDP) and assessment methods of trade-offs between human activities and biodiversity benefits derived from MPAs (WGMPAS).

WGMME will report by 2 March 2023 for the attention of ACOM.

Supporting information

Priority	The activities of this Group contribute to the understanding of the ecological role of marine mammals.
Scientific justification	ToRs a and b are standing terms of reference. Its scope was expanded by toR c) since it would be useful to include information on threats to population status, including cumulative effects of multiple stressors. ToR d reflects common interests between WGMME and WGBYC, including some aspects of marine mammal fishery interactions may otherwise not be covered by either group. Detailed content of this ToR will be agreed between WGMME and WGBYC in consultation with the ICES Secretariat. ToR e will support collaboration between WGMME and other relevant ICES WGs.
Resource requirements	None.
Participants	The Group is expected to be attended by 15–20 members.
Secretariat facilities	None beyond sharepoint facilities and editorial support for the report.
Financial	None.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGBYC, WGHARP, WGBIODIV, WGMPAS, WGSAM, WGJCDP, EPDSG, SCICOM
Linkages to other organizations	OSPAR, HELCOM, ASCOBANS, IWC

Joint ICES/ PICES Working Group on Small Pelagic Fish (WGSPF) – pending submission

2022/FT/EPDSGXX

Pending submission

Joint ICES/ PICES Working Group on Impacts of Climate Warming on Growth Rates and Fisheries Yields (WGGRAFY)- pending submission

2022/FT/EPDSGXX

Pending submission

Working Group on the Biology and Life History of Crabs (WGCRAB) – pending submission

2022/FT/EPDSGXX

Pending submission

Working Group on Fisheries-Induced Evolution (WGEVO) – pending submission

2022/FT/EPDSGXX

Pending submission

Resolutions approved in 2021/2022

Scallop Assessment Working Group (WGScallop)

2022/FT/EPDSG01 The Scallop Assessment Working Group (WGScallop), chaired by Lynda Blackadder, Scotland, United Kingdom and Isobel Bloor, United Kingdom* 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	3-7 October	Iceland	E-evaluation and interm report by November 2022	Lynda Blackadder
Year 2023	9-13 October	Tromso, Norway	E-evaluation and interm report by November 2023	New co-chair-Isobel Bloor
Year 2024			Final report by November 2024	Co-chair expected

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Compile and present data on scallop fisheries in ICES areas II, IV, V, VI and VII by collating available fishery statistics.	The WG established a data call but will address known issues and improve and streamline the process. Data reporting, presentation and options for long term storage will be reviewed.	5.1	3 years	Include updated figures and tables in annual WG reports. Upload scripts to GitHub. Report on possible database options.
b	Review recent/current stock assessment methods of the main scallop species and explore other methodologies; including comparisons with fishery dependent indicators and potential utilisation of oceanographic data within the assessment process.	The WG has made considerable progress to develop stock assessment methodologies for scallop species and this work should continue. Links have been established with WGNSSK to further consider SPiCT for scallop stock assessment, and with WGOOFE.	5.1,6.3	3 years	Report on stock assessments methodologies and results for all stock areas and consider reference points. Formalise the checking process for stocks. Establish working relationships with WGNSSK and WGOOFE.

c	Conduct a stock assessment for the north east Irish Sea and work with WGOOFE to include environmental variables where appropriate.	Available data have been collated and work on this ToR is underway. Links established with WGOOFE, WGNSSK and WGSFD.	5.1, 6.2	3 years	Produce stock indices and apply SPiCT model (upload to Github). Analyse links with environmental variables. Develop ICES Viewpoint in cooperation with ACOM leadership and conduct Management Strategy Evaluation.
d	Review and report on current scallop surveys and share expertise, knowledge and technical advances. Review electronic monitoring (EM) for scallop fisheries.	Surveys continue to be important for data collection for scallop stocks and sharing knowledge on methodology and advances in technology is important as electronic monitoring and camera systems become more common.	1.5, 4.4, 5.4	3 years	Dredge efficiency review paper (link with ToR f). Scientific staff exchange on surveys. Report on EM and collaborate with WGSFD.
e	Continue to refine stock structure using best available information on genetics and larval dispersal and improve current mapping of scallop stocks. Establish links with WGOOFE to collaborate on specific work areas.	Undersanding the biological stock area to determine if the assessment areas are appropriate. A number of new members have recently joined the WG and it is hoped the PhD projects can support this ToR.	1.4, 1.8	3 years	Report on PhD progress. Maps for each of the scallop stock areas.
f	Review current biological parameters and update when more information becomes available and report on all relevant aspects of: biology, ecology, physiology and behaviour, in field and laboratory studies.	Several biological parameters are important for analytical assessments. Differences in growth rates will be examined in detail. The group are reviewing dredge efficiency.	5.1, 5.2	3 years	Dredge efficiency review paper (link to ToR d). Report on growth studies.
g	Compare age reading methodologies and develop common practices and determine precision and bias of scallop age reading data derived from different readers.	Most institutes rely on aging methods and so this work is still important to continue.	4.4, 5.1	3 years	Attend WKSA. ICES TIMES document on aging methodologies.

h	Identify, list and collate all available data for queen scallops and agree on appropriate stock assessment areas. Share knowledge, draft a review paper and attempt stock assessments where possible.	The WG would like to focus more attention on this species. A subgroup will be formed to lead on this. Data are already collected through the data call and surveys.	5.1, 6.3	3 years	Report on progress. Draft a review paper. Create maps of stock areas.
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Summary of the Work Plan

YEAR 1	<p>Linked to ToR;</p> <p>a) Refine data call, highlight and address issues.</p> <p>b) Continue to explore index standardization and stock assessment methodologies including surplus production model for scallop stocks (and establish closer links with other assessment WGs (WGNSSK)</p> <p>c) Apply a SPiCT model for the Isle of Man, using survey and CPUE (VMS/logbook) indices standardized with VAST. Continue to explore other alternative models and establish communications with WGOOFE.</p> <p>d) Continue to report and share knowledge on surveys and plan for scientific staff exchange.</p> <p>f) Dredge efficiency review paper</p> <p>h) Form subgroup for queen scallop work</p> <p>Establish links with WGNSSK, WGSFD and WGOOFE with regular communications</p>
Year 2	<p>Linked to ToR;</p> <p>a) Data call - streamline and document checking process (upload scripts to GitHub)</p> <p>b) Review scallop ICES stock categories and discuss possible reference points (following ICES guidelines from WKREF2)</p> <p>c) Incorporate other spatial areas and environmental variables from the Irish Sea (collaborative work with WGOOFE)</p> <p>d) Undertake scientific staff exchange on scallop surveys.</p> <p>g) TIMES document on aging methodologies in collaboration with WKSA</p>
Year 3	<p>Linked to ToR;</p> <p>a) Data call – need to consider long term storage options (central database/RDB)</p> <p>b) Set up a more formal checking and review process for stock assessments</p> <p>c) Produce Viewpoint and Management Strategy Evaluation of Irish Sea scallops.</p> <p>d) Report on electronic monitoring (EM) for scallop fisheries and collaborate with WGSFD to produce mapping products.</p> <p>h) Queen scallop review paper</p>

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 resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by 25–30 members and guests.
Secretariat facilities	None.

Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages as this WG does not currently provide advice but we have discussed the possibility of developing a Viewpoint in cooperation with ACOM leadership for the work we are progressing for an Irish Sea stock assessment for king scallops.
Linkages to other committees or groups	There is a very close working relationship with WKSA, and we have provisionally agreed to work with members of WGOOFE, WGSFD and WGNSSK. Communication links have been established and the chair will seek to formalise agreements.
Linkages to other organizations	None

OSPAR/HELCOM/ ICES/Working group on Seabirds (JWGBIRD)

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group.

2021/OT/EPDSG02 JWGBIRD 3-year workplan can be found here:

<https://www.ices.dk/about-ICES/Documents/Resolutions/Science%20EG%20ToRs/EPDSG/2021/JWG-BIRD%20ToRs%202021%E2%80%932023.pdf>

Working Group on Biodiversity Science (WGBIODIV)

2021/FT/EPDSG03 The **Working Group on Biodiversity Science (WGBIODIV)**, chaired by Murray Thompson, UK, and Ute Jacob, Germany, 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	7–10 June	Oldenburg, Germany	Interim e-evaluation	
Year 2023	24–28 April 2023	TBD	Interim e-evaluation	
Year 2024			Final report by Date to SCICOM	

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Using complementary measures to provide a multidimensional perspective of biodiversity change.	Efforts to manage and conserve marine biodiversity depend on our ability to understand the mechanisms that affect ecosystem stability at a range of spatial scales, including sufficiently large	1.1 1.2; 1.3	3 years 3 years	Provide a framework and data on how to link ecosystem services directly to marine biodiversity. Production of peer reviewed paper and/ or conference paper. Evidence for ecosystem management

		<p>scales that meet international strategies and directives (e.g. OSPAR, MSFD). The approach to understanding ecosystems using complementary indices which afford a multidimensional perspective of biodiversity change (e.g., trait and taxonomic diversity in their alpha, beta and gamma forms) provides a way to examine stability and variability at multiple scales (Wang and Loreau 2014; Thompson et al 2020). For instance, both variability in species diversity and spatial heterogeneity play important roles in maintaining resource availability via so called 'Portfolio Effects' (Thorson et al. 2018). To our knowledge, however, such patterns in biodiversity across assemblages have not been considered in this context. This ToR (a) will: assess multidimensional biodiversity patterns across assemblages (1.2); make predictions of ecosystem structure and function in space and time relevant for management and service provision, e.g. in designated areas where there is currently limited information (i.e. spatial ToR) and in future under varying climate scenarios (1.3).</p>			<p>and policy, e.g. maps showing biodiversity patterns in space and change over time delivered through WG report.</p>
b	<p>Thresholds responses of marine biota and ecosystem structure: identify areas where marine biodiversity is particularly at risk.</p>	<p>Robust information on the spatial distribution of biota and anthropogenic drivers of change are critical to direct conservation efforts (2.1).</p> <p>Identifying where along anthropogenic pressure gradients notable ecosystem shifts take place will help to inform meaningful and cost-effective interventions. Such thresholds were recently demonstrated for the benthos (Couce et al. 2020) illustrating levels of trawling, for example, at which faunal communities undergo significant change, with consequent effects on ecosystem functioning.</p> <p>ToR (b) will: identify where diversity, ecosystem function (e.g. production and consumption) and ecosystem services (e.g. carbon storage) are particularly at risk, e.g. where thresholds for several pressure gradients coincide and where policy intervention may</p>	2.1	3 years	<p>Literature review of threshold responses across realms, habitats, ecosystem components (do biodiversity thresholds exist?)</p>
			2.2	3 years	<p>Compile relevant data sets across ecosystem components (benthic invertebrates, plankton, fish, elasmobranchs, mammals)</p>
			2.3	3 years	<p>Production of peer reviewed paper and/ or conference paper. Evidence for ecosystem management and policy, e.g. maps showing areas where marine biodiversity is particularly at risk delivered through WG report.</p>

		thus be particularly effective (2.2, 2.3).			
c	Examine the efficacy of spatial protection measures to conserve and protect biodiversity and meet wider aims (ecosystem function and services).	<p>The United Nations Sustainable Development Goal ‘to ‘Conserve and sustainably use the oceans, seas and marine resources’ requires governments to assess and mitigate our impact on marine ecosystems.</p> <p>We can manage our pressures through limiting their ‘footprint’ (spatial protection) and also the level of pressure (e.g. limiting fisheries catches). Understanding which management measures will be most effective requires us to assess, quantify and predict the trajectory of ecological recovery resulting from spatial protection measures. ToR (c) will use data on faunal distribution, spatial protection measures and heterogeneous (e.g. fishing) and large-scale pressures (e.g. warming) identified in ToRs a, b. ToR (c) will establish status, trends and threats (i.e. pressures) for species and habitats of interest (3.1); establish the wider effects of spatial protection measures on biodiversity in light of primary and cumulative pressures (e.g. as identified in ToRs a, b; 3.2); establish the effects of man-made structures on biodiversity (EcoStar, FuECoMMS, DREAMS; 3.3).</p>	3.1; 3.2; 3.3	3 years	Production of peer reviewed paper and/ or conference paper. Evidence for ecosystem management and policy, e.g. biodiversity status, trends and threats (inc. cumulative pressures and evolving energy infrastructure) in areas of interest, delivered through WG report.

Summary of the Work Plan

Year 1	Work on all ToRs
Year 2	Work on all ToRs, Publications
Year 3	Work on all ToRs, Publications

Supporting information

Priority	The current activities of this group will lead ICES into issues related to the integrated ecosystem assessments and the implementation of the ecosystem approach to marine management. 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 ca. 20 members and guests.
Secretariat facilities	Standard EG support
Financial	No financial implications.

Linkages to ACOM and group under ACOM	There is a linkage to the Integrated Ecosystem assessments Steering Group (IEASG). The results of WGBIODIV are important to WGECO and may be of relevance for IEA groups.
Linkages to other committees or groups	The outcomes of WGBIODIV will be important to the ICES high priority work area 'Marine Strategy Framework Directive (MSFD)'. Linkages to JWGBIRD and WGMME exist.
Linkages to other organizations	OSPAR, HELCOM, European Commission

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	Online meeting		
Year 2023	20-23 March	ICES HQ, Copenhagen, Denmark		
Year 2024			Final report by DATE to SCICOM	

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN		EXPECTED DELIVERABLES
			CODES	DURATION	
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	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.

		other users.			
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 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.	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 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	Joint activities with other EGs	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 or contentious existing taxa sightings 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	3.3; 4.1	ongoing review every 3 years	A template database populated by content on WGPME and/ or other sites

sightings will be recorded continuously and reviewed every three years to write a paper or provide information to other ICES expert groups.

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 belonging 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.

Working Group on Crangon fisheries and life history (WGCRAN)

2021/FT/EPDSG05 The Working Group on *Crangon* fisheries and life history (WGCRAN), chaired by Kim Hünerlage, Germany, and Eva Maria Pederson, Denmark 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	21–23 June	Bremerhaven	Interim e-evaluation	
Year 2023	June 2023 (TBD)	Belgium (TBD)	Interim e-evaluation	
Year 2024			Final report by Date to SCICOM	

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Data collection of the status of the <i>Crangon</i> stock.	Report and evaluate population status indicators like recent landings and effort trends in the brown shrimp fisheries. Generate a standardized lpue time-series and provide a detailed description of the process of collecting the dataserie effort, landings & lpue for WGCran.	1.1; 2.1	year 1,2,3	A time-series analysis of the standardized stock indicators will be delivered by all WGCran members within the annual report(s)
b	Compilation of Logbook information & VMS analysis	To combine VMS, landings and effort data to develop a spatial indicator of shrimp distribution based on LPUE and to monitor regional distribution and regional shifts in fishing effort.	2.1; 2.4; 3.5; 5.4	year 1,2,3	Results will be presented in the annual report(s)
c	Development of decision-support tools for brown shrimp harvesting	To develop and evaluate brown shrimp-specific management decision-support tools to evaluate strategies on how to sustainably and efficiently harvest the brown shrimp stock.	2.1; 2.2; 5.1; 5.4 6.1	year 1,2,3	Results will be presented in technical reports, summarized in a peer-reviewed paper and included in the annual report(s)
d	Assessment of brown shrimp bycatch	Review the status and results of research on bycatch timeseries and consider the implications for management. Evaluate methods and procedures used on board for collecting data on bycatch. Gather, compile and evaluate information on the onboard and ashore sieving fractions and processes and new national bycatch/discards data from e.g. DCF.	3.1; 3.2	year 1,2,3	Results as well as updates on the development of sampling procedures will be presented in the annual report(s)
e	Analysis of spatio-temporal trends of survey based stock indicators	Analysis of German, Belgian and Dutch scientific survey data to assess spatio-temporal trends of survey based stock indicators (e.g.	3.1; 3.2	year 1,2,3	Results will be presented in the annual report(s)

		biomass, length distribution, mortality); Ground-truthing of VMS derived l _p ue estimates.			
f	Overview of Legislation, Law and Management	Information on national legislation, laws and management concerning the brown shrimp fisheries in the whole North Sea will be synthesised (e.g. Natura 2000, MSC process, landing obligation,...).	7.1	year 1,2,3	An overview and update of relevant information on legislation, law and management will be included in the annual report(s)
g	Overview of ongoing research	Present and review ongoing brown shrimp research in the ICES area (impact studies, development of fishing gears, life cycle studies...) aiming at supporting international collaboration as well as evaluating management implications.	6.1	year 1,2,3	The summaries of updates on ongoing research will be included in the annual report(s)

Summary of the Work Plan

Year 1	<p>Stock status indicators will be updated and harmonized between countries (ToR a). German and Dutch survey data will be analysed and reported, Belgian data will be included in the analyses (ToR e). Data used for the compilation of manuscripts in support of ToR b and c will be made available. Information and updates on national legislation, laws and management concerning the brown shrimp fisheries will be summarized (ToR d and f). New information generated from ToR g will be reported.</p>
Year 2	<p>Stock status indicators will be updated and harmonized between countries (ToR a). German, Belgian and Dutch survey data will be analysed and reported (ToR e). Data used for the compilation of manuscripts in support of ToR b and c will be made available. Information and updates on national legislation, laws and management concerning the brown shrimp fisheries will be summarized (ToR d and f). New information generated from ToR g will be reported.</p>
Year 3	<p>Stock status indicators will be updated and harmonized between countries (ToR a) as well as German, Belgian and Dutch survey data will be analysed and reported (ToR e). Data used for the compilation of manuscripts in support of ToR b and c will be made available. Information and updates on national legislation, laws and management concerning the brown shrimp fisheries will be summarized (ToR d and f). New information generated from ToR g will be reported.</p>

Supporting information

Priority	<i>Crangon</i> fisheries are economically important with landings value ranking this species among the top three species caught from the North Sea. The priority of WGCAN is to understand the interactions between the brown shrimp population (structure and abundance) and human behaviour (mainly fishing effort), the environment, and the ecosystem. One important aspect is and will be the monitoring, investigation and development of population status indices. WGCAN is the only expert group to evaluate the Brown Shrimp Fisheries Management Plan which was developed by the industry in the course of the MSC certification.
Resource requirements	The research programmes that 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 10 members and guests.
Secretariat facilities	Standard EG support.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	WGCAN aims at a permanent linkage with ACOM after year 2 when sound and proven stock indicators and tools to evaluate management strategies have been developed (ToR a, b, c).
Linkages to other committees or groups	There is a linkage to WGBEAM through the international scientific surveys (DFS & DYFS). WGINOSE by providing data for the integrated assessment. WGSAM as the SMS key runs will be used to estimate natural mortality of brown shrimp. Members of WGCAN are also members in these groups.
Linkages to other organizations	CWSS = Common Wadden Sea Secretariat; TMAP = Trilateral Monitoring and Assessment Programme; RCM – NSEA

Working Group entitled “Towards a EUROpean OBServatory of the non-indigenous calanoid copepod *Pseudodiaptomus marinUS*” (WGEUROBUS)

2021/FT/EPDSG07 The Working Group entitled “Towards a EUROpean OBServatory of the non-indigenous calanoid copepod *Pseudodiaptomus marinUS*” (WGEUROBUS), chaired by Marianne Wootton, United Kingdom, and Marco Uttieri, Italy, 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	27 October	Online	Interim e-evaluation	
Year 2023	October (tbd)	Naples, Italy (tbd)	Interim e-evaluation	
Year 2024	October	Copenhagen, Denmark (tbc)	Final report by 15 December to SCICOM	

ToR descriptors

TO R	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Compile and analyse data	Since its first record in	1.3; 1.9	Years 1-3	One published peer-

	on the geographical distribution, seasonal patterns and interannual variations of <i>Pseudodiaptomus marinus</i> in European waters.	2007 in the Adriatic Sea, the non-indigenous calanoid copepod <i>P. marinus</i> has spread in numerous areas of European seas, and it is now present in the eastern Atlantic coasts, the southern North Sea, the Mediterranean Sea and the Black Sea. The spreading process is still ongoing, and shows the great ability of this non-indigenous species to adapt to environments characterised by wide temperature and salinity ranges. The ToR will continue the activities carried out in the previous term, focusing on the monitoring of the introduction and settlement, and also on the comparative analysis of the temporal patterns in different sites.			reviewed publication (tentative title: "Comparison of seasonal patterns of <i>Pseudodiaptomus marinus</i> in coastal and estuarine systems in southern Europe") and one manuscript to be submitted by the end of the ToR (tentative title: "Interannual variation of <i>Pseudodiaptomus marinus</i> in European coastal waters") One presentation at a conference
b	Identification of key ecological, biological and behavioural traits of <i>Pseudodiaptomus marinus</i> .	Several biological, ecological and behavioural traits seem to confer <i>P. marinus</i> specific abilities by which adapting to a wide gamut of environmental conditions. Such plasticity may likely represent the key to success of <i>P. marinus</i> , explaining its introduction and settlement in diversified sites. The ToR will investigate the key traits of this NIS, providing cues to understand its spreading but also its potential use in applied research, for example as feed for fish larvae or as model organism in ecotoxicology studies.	1.7	Years 1-3	One manuscript to be submitted by the end of ToR (tentative title: "Invasive ecology concepts explained by <i>Pseudodiaptomus marinus</i> "). One presentation at a conference
c	Molecular and morphological identification of <i>Pseudodiaptomus marinus</i>	The molecular characterisation of <i>P. marinus</i> specimens from different sites can shed	4.4	Years 1.3	Two manuscripts to be submitted by the end of ToR (titles to be defined)

	occurring in different environments in European waters.	light into the possible presence of different ecophenotypes, as well as on their phylogeographical distribution. The ToR will delve into these aspects by coordinating and promoting the comparison of results obtained by using different primers. The ToR will also perform morphometric analysis of specimens from different sites to depict potential site-dependent phenologies or morphological variability.			One presentation at a conference Population of repository established at Stazione Zoologica Anton Dohrn during the 2019-2021 term
d	Establishing trophic position and interactions of <i>Pseudodiaptomus marinus</i> .	Trophic interactions are key determinants of population abundance and dynamics, the structure and persistence of communities, and the rate and sustainability of ecosystem processes. In non-indigenous species, these interactions can cause substantial ecological impacts on the native food webs, yet are largely unexplored. ToR d aims at understanding the trophic position and potential impacts of <i>Pseudodiaptomus marinus</i> on food webs in European waters using stable isotope analysis and DNA metabarcoding (by sequencing 16S rRNA and 18S rRNA genes using host-blocking primers to identify prokaryote and eukaryote potential prey present in <i>P. marinus</i> guts).	1.8, 4.4	Years 1-3	One manuscript to be submitted by the end of ToR (title to be defined) One presentation at a conference

Summary of the Work Plan

Year 1	The WG will continue the activities already initiated during the first three-year term, and will set the basis for the activities proposed for the new ToR d.
Year 2	The WG will focus on the implementation of the ToR activities, in particular those necessitating exchange of data between the members.
Year 3	The WG will concentrate on the completion of the tasks and on the production of manuscripts.

Supporting information

Priority	The outcomes collected during the first three-year term demonstrated the interest of studying <i>P. marinus</i> , as its spreading is continuing at a fast pace but the long-term effects of its introduction in new systems is still unknown. In addition, the species is a candidate for massive cultivation and as a model organism for ecotoxicology studies. The connections established by WG members have created a collaborative network, stimulating the sharing of ideas and data.
Resource requirements	The research programmes which provide the main input to this group are already underway and resources are already committed. No ICES resources are required.
Participants	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities	Standard WG support.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	The activities of the WG can provide information about the invasiveness of this NIS, its means of introduction and optimal sampling strategies. This may be important to ACOM to provide indications by which optimising the monitoring strategies for NIS, as for example within the MSFD.
Linkages to other committees or groups	The WG has established connections with WGIMT and WGZE, both under EPDSG, with whom the WG shares scientific interests and methodologies. Recently, still within EPDSG, new connections are being established with WGOOFE and BEWG. Linkages with other WGs belonging to other SG are envisaged.
Linkages to other organizations	The work of this group is potentially aligned with similar work by the Intergovernmental Oceanographic Commission of UNESCO (IOC) and the International Maritime Organization (IMO).

Resolutions approved in 2020

Working Group on Operational Oceanographic Products for Fisheries and Environment (WGOOFE)

2020/FT/EPDSG02 The Working Group on Operational Oceanographic products for Fisheries and Environment (WGOOFE), chaired by Francisco Campuzano, Portugal, and Tomasz Dabrowski, Ireland, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	25–26 November	Online meeting	Interim e-evaluation	
Year 2022	22–23 November	Online Meeting	Interim e-evaluation	
Year 2023	TBD	TBD	Final report by December 2023	

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Engage in collaboration with relevant end-users and EGs to develop oceanographic and ocean products for fisheries and aquaculture applications.	Ocean data supplied from operational modelling has reached a mature state and services based on this information are continuously increasing. The challenge is to co-develop fit-for purpose services and to incorporate the environmental information in traditional assessment performed by fisheries managers from the ICES community and to support aquaculture activities. ICES WGs from EPDSG, IEASG and ASG will be invited to attend the WGOOFE meetings giving priority to the host country.	1.2, 1.3, 2.5, 4.2	3 years	Production of a 'Proof of Concept' (PoC) example to showcase the application of operational products (remote sensing and numerical models) in integrated ecosystem assessment. Relevant Chair(s) of other WGs will be encouraged to identify the products that will be relevant to their assessments and required formats. Remote calls will be organized with the ICES data centres and the ecosystem overviews WGs. Other ICES WGs linked to assessment will be invited to each WGOOFE meeting.
b	Respond to ad hoc	WGOOFE will distribute	5.3, 6.1,	3 years	Involvement of

	advisory requests on oceanographic products for the ICES ecosystem modelling, advisory and ocean observing communities, when needed. To increase profile and disseminate across the ICES community the availability of oceanographic datasets, products and time-series.	among their members the requests made to ICES SCICOM and will produce and provide the required information with reasonable timings. WGOOFE will contribute with operational information from numerical models and EOs to the elaboration of ICES ecosystem overviews and integrated ecosystem assessments collaboration with IEASG WGs.	6.4, 6.6		WGOOFE in ICES workshops where operational products are needed. Reports for specific requests. WGOOFE co-promotion and co-organisation of oceanography sessions in ICES ASC. Develop fact sheets for ICES expert groups and further targeted meetings with groups and workshops.
c	To develop 'fit for purpose' case studies to showcase applications of oceanographic products in integrated assessments and advice. The demonstration will include adequate environmental variable(s) and/or index(es) that could aid fisheries management or assessment. Since this is a novel approach, the method will be continuously evaluated. WGOOFE will enable linking ICES activities with the EU MSFD. To ensure Good Environmental Status the European Member States need to monitor and provide indicators that could benefit the integrated ecosystem overview reports.	Despite high quality level of operational oceanography products, their use for fisheries stock assessment or integrated ecosystem assessments is still in an early stage WGOOFE will promote the use of operational products. Clearly described case studies are required in order to demonstrate best practice and to increase user confidence in using the products of operational oceanographic services. MSFD is the most important legislation related to the environmental status of European Waters. Linking MSFD and ICES indicators and evaluation is mutually beneficial.	6.6, 6.1, 6.2, 1.2	3 years	Production of fact-sheets style documents with index-based products of environment and oceanographic change (in addition to ICES own operational ocean products). WGOOFE will provide MSFD indicators and ICES indicators at least for the Atlantic European Waters through the iFADO project (www.ifado.eu) and will promote same activities in other ICES waters.

Summary of the Work Plan

Year 1	Reactivate the WGOOFE members and enlarge the WG community. Organise the first online meeting and explain this 3-year period ToRs. Propose on-line meetings every 6 month period. Case Study Development: Approach regional assessment expert groups (e.g. WGINOSE,
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	<p>WGEAWESS, WGNARS) to start process.</p> <p>WGOOFE needs to increase the current end-user involvement at its own meetings, and the strategy to overcome this situation is to ask WGOOFE members to contact ONE local relevant expert group. On each in-person meetings, the local-end user will be invited to gather their data needs and to explore how defined products can be used.</p> <p>Approach WGOH about using spatial ocean data in IROC (e.g. Copernicus SST). In the first meeting a list of indices will be presented and members will select the implementation order moving from simple to more complex indices including fish/fisheries, MSFD (OSPAR common indicators), climate change, etc.</p> <p>First face to face meeting in summer/autumn 2021. The meeting will take place in Lisbon and will invite WGs related to local fisheries in order to setup the communication between WGs where scientific research questions to be defined, such as: what is the impact of ingesting different data sources into assessment models (integrated/fisheries/...). Set up working plan for Year 2 based on developments. Remote attendance via online applications will be provided to facilitate a broader participation.</p>
Year 2	<p>Second face to face meeting- WGOOFE meeting, in summer/autumn 2022 most probable in Ireland. Invite other ICES WG that could be relevant for the host country fisheries. Production of the first WGOOFE Indicators report.</p> <p>Evaluation/reporting of results from first year work including indices generation and collaboration with the assessment WG. Indicator results should include synthesis, presentation (ensembles, comparisons) and data visualisation.</p>
Year 3	<p>Third face to face meeting- WGOOFE meeting, in summer/autumn 2023 location to be defined. Invite other ICES WG that could be relevant for the host country fisheries. Production of the second WGOOFE Indicators report.</p> <p>Evaluation/reporting of results from second year work including indices generation and collaboration with the assessment WGs.</p> <p>Election of new/current WG chairs and definition of ToRs for the next 3-year period.</p>

Supporting information

Priority	The current activities of this Group will lead ICES into issues related to the provision of integrated ecosystem management and advice.
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 10–20 members and guests.
Secretariat facilities	Standard support to WG.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	The integrated ecosystem assessment working groups, as well as any other advisory groups which would benefit from environmental and oceanographic information being incorporated in their advisory work.
Linkages to other committees or groups	There is a very close working relationship with WGOH and WGS2D as well as WGEAWESS.
Linkages to other organizations	OSPAR, CMEMS, EMODnet, EuroGOOS

Benthos Ecology Working Group (BEWG)

2020/FT/EPDSG03 The **Benthos Ecology Working Group (BEWG)**, chaired by Johan Craeymeersch, the Netherlands; and Paolo Magni, Italy, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	10–14 May	Online meeting	Interim e-evaluation	
Year 2022	9–13 May	Oristano, Italy	Interim e-evaluation	
Year 2023	8–12 May	Bergen, Norway	Final report by 1 July 2023 to SCICOM	

ToR descriptors

ToR	Description	Background	SCIENCE PLAN TOPICS ADDRESSED	Duration	Expected Deliverables
A	Long-term benthic series and climate change To identify methodological issues in long-term series comparability	The need for the BEWG to work on current tools and techniques associated to the underpinning of natural variability changes and climate changes onto the benthos is of importance. There is a need to review and compile methodological issues (e.g. methods, tools) associated to long-term series comparability in marine assessments..	1.1; 1.3; 1.4	Years 1-3	On track- opinion paper drafted on current methodological applications
B	Species distribution modelling and mapping To discuss and explore relevant case studies (e.g. functional mapping) and ongoing developments (modelling approaches) in this field.	BEWG will report performance of different qualitative and quantitative approaches and will consider new methods and applications , e.g. processes and functions as tools to support modelling and mapping approaches	1.6; 1.7; 1.9	Year 1-3	NEW- discussion and exploration with case study to show case applications.
C	Benthos and legislative drivers 1. To report on the use of benthic indicators and targets for management: Compatibility and complementarity. 2. To report on the myths on indicators: To investigate the importance of species autecology in indicator development and application.	1. Contributing to the unravelling of the EU MSFD D6 'Seafloor integrity' assessment criteria in alliance with the respective regional (OSPAR, HELCOM, Barcelona), EU TGSeabed and other ICES working groups	7.1; 3.1; 3.2	Years 1-2 Years 1-3	NEW-Position paper NEW- Research paper.

	3. To review the development of effective monitoring programmes, e.g. design, techniques, improvements, harmonisation and quality assessments.	(WGFBIT, WGBIODIV). ICES BEWG will focus on the practical implementation of the D6 criteria for determining the benthic seafloor status on spatial scale, based on existing indicator approaches through case studies.		Years 1-2	NEW- Review paper
	4. To review the development of new molecular genetic techniques and the application of the methods for biodiversity and environmental assessments.			Years 1-2	NEW- review aper
D	Benthic biodiversity and ecosystem functioning	Disentangling the link between biodiversity and ecosystem functioning is currently considered to be key to fully understand the health of marine ecosystems. This topic hence became a cross-cutting theme since the BEWG 2012 meeting. The BEWG will therefore review and identify benthic indicators to reflect the link between biodiversity and ecosystem functioning and review how ecological function and diversity relates to different parts of the benthic communities at different spatial scales, taking account of e.g. ecological processes and biological traits. BEWG will also scope for research on the functional diversity of macrobenthos in relation to ecosystem functioning.	2.2; 2.3; 2.4		
	1. To report on the ongoing case studies to assess ecological responses across sediment gradients.			Years 1-2	ONGOING-Research paper to report on a selected case study.
	2. To consider new functional indicator needs to support MSFD requirements.			Year 1-3	ONGOING-Viewpoint paper
E	Benthic biodiversity and conservation: to review the role of benthic ecology in MPAs	Understanding ecological issues associated to the development/proposal of MPAs and how effective MPAs are going to be for the conservation of priority benthic species is key to support conservation and management strategies. This TOR is relevant with regards to ongoing issues (i.e. management measures) being applied within MPAs. This work brings understanding to safeguard the species in need of protection, creating further repercussions to the	6.1; 6.2; 6.4	Years 1-3	NEW- Review paper

ecosystem function and processes in specific habitats and species.

This ToR will consider issues associated with conservation/restoration, Autecological/environmental as well as human issues.

Summary of the Work Plan

Year 1	ToRs a., b.1, c.1-4, d.1-2, e.1.
Year 2	ToRs a., B.1, C.1-4, D.1-2, e.1.
Year 3	ToRs A., B.1, C.1-4, D.1-2, e.1.

Supporting information

Priority	The current activities of BEWG will continue along the main priority within BEWG ToRs, based on: long-term series and climate change, benthic indicators and EU directives, and species distribution modelling, and one cross-cutting (horizontal) axis on benthic biodiversity and ecosystem functioning (including issues directly in connection to MPAs). The BEWG work and TORS are aligned with the ICES Science Programme and are of high priority. The BEWG are active contributors and aim to report their outcomes directly to ICES in their annual report, Biodiversity highlights and in parallel as peer reviewed literature. Some of the outputs will be submitted to ICES JMS, Ecological Indicators, Marine Pollution Bulletin, etc.)
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 20-30 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There is a possibility for interaction of several ICES expert groups, among which WGBIOD, WGCEA, WGDEC, WGVMS, WGECE, WGMHM and WGEXT.
Linkages to other organizations	The group has had also interaction with OSPAR IGC-COBAM.

ICES/ IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD)

2020/FT/EPDSG04 The ICES-IOC Working Group on Harmful Algal Bloom Dynamics, chaired by Dave Clarke, Ireland, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	20–23 April	Online meeting	Interim e-evaluation	
Year 2022	14–17 June	Weymouth, UK	Interim e-evaluation	
Year 2023	20-24 March	Stazione Zoologica, Naples, Italy	Final report by 1 May to SCICOM	

ToR descriptors

ICES-IOC WGHABD had a long discussion at the beginning of the 2020 meeting about developing a new suite of ToRs for the coming reporting cycle and how they would align with the UN Decade of Ocean Science for Sustainable Development. ToR h has been developed in the context of this longer-term view.

TO R	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Deliver National Reports on harmful algal events and bloom dynamics for the years 2020, 2021 and 2022.	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 <i>Ecosystem Science, Seafood Production, Conservation and Management Science</i> .	1.3, 5.6, 6.5	Year 1,2,3	Yr 1-3 Summary of national reports in Annex in WGHABD annual scientific report. These will also support events reported in ICES-PICES-IOC HAEDAT database and annual HAEDAT maps that will be used.
b	Progress in the discovery of climate-driven changes in the distribution of planktonic and benthic HAB taxa (incl. cyanobacteria) will be reported by the WG members. In addition, the WG will have a yearly thematic focus on specific HAB topics in relation to climate change to improve our foresight and engage more scientists during the reporting period 2021-2023. Yr1: Climate-driven	The effects of climate change on HABs is an area of interest due to potential negative impacts on the ecosystem and ecosystem services. The changing distributions of HAB species in the Arctic and increasing records of impacts from benthic HABs in Europe create unique challenges and opportunities to study HAB dynamics in relation to climate change. New approaches have also been	1.3, 5.6, 6.5	Year 1,2,3	Yr 1: Update WG on the emerging issues with <i>Gambierdiscus</i> spp. and Ciguatera Fish Poisoning with a focus on environmental influences including climate. Report on the findings of CoClima project related to benthic HABs such as <i>Ostreopsis</i> spp and relevant activities under GlobalHAB. Yr 2: Report new discoveries on the diversity and distribution of HABs in the Arctic, with particular

	<p>changes in benthic HABs</p> <p>Yr2: HABs in the Arctic environment</p> <p>Yr3: Hindcasting the past to understand the future</p>	<p>developed focusing on the sediment archive to understand the dynamics of HABs in the past. When merged with Earth System models, the ecological knowledge gained from these activities to improve our seasonal to decadal forecasting capabilities. This ToR links to Science Priorities <i>Ecosystem Science</i>, <i>Seafood Production</i>, <i>Conservation and Management Science</i> and will link to future ICES Science and advisory activities focussing on Climate Change and Arctic science.</p>			<p>attention to fjord regions and their coastal resources, and climate drivers that steer the community dynamics of functional groups in the Arctic.</p> <p>Yr 3: Review the potential of sedimentary DNA and ancient DNA to study past HAB dynamics and search for commonalities with sedimentary cyanobacterial HAB reconstructions.</p>
c	<p>The ICES-PICES-IOC harmful algal event database (HAEDAT) will be updated by delegates on an annual basis. HAEDAT can be used to produce 'products' such as spatial descriptions of harmful algal events in the ICES area. Examples include maps of incidence of management actions associated with toxicity and/or mortalities which can be fed into ICES Ecosystem Overviews that can be updated annually or as required. The processes of using HAEDAT during the production of the IOC Global HAB report will be reviewed. The feasibility of compiling a parallel dataset of phytoplankton and toxicity data from selected stations in the ICES area as a supplement to event data and to build time series of HAB and toxicity occurrences will be investigated.</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 <i>Ecosystem Science</i>, <i>Seafood Production</i>, <i>Conservation and Management Science</i> as well as contributing to the 'Safe Ocean' objectives of the UN Decade for Ocean Science for Sustainable Development.</p>	1.3, 5.6, 6.5	Year 1,2,3	<p>Yr 1-3 Delegates update HAEDAT. Liase with IOC about HAEDAT as required.</p> <p>Yr 1 Entry forms reviewed, particularly in relation to fish mortalities, and recommendations passed to IOC.</p> <p>Yr 2 Identify time-series of phytoplankton counts and toxin concentrations and products to be generated.</p> <p>Yr 3 Review of reporting products from HAEDAT and time series datasets. Presentation at ICHA conference.</p> <p>Production of factsheets from the ICES area to promote information from HAEDAT.</p>
d	<p>In the aquatic environment globally, a wide range of natural compounds from microalgae, cyanobacteria</p>	<p>New toxin detection methods are continually in development, this allows new information</p>	1.3, 5.6	Year 1,2,3	<p>Yr 1 &2: Members to update group on emerging toxin discoveries from their</p>

	<p>and unknown sources are considered as toxins and pose a risk to food safety. Additionally, new discoveries continue to be made within existing toxin groups and new information can lead to a reassessment of the toxicity of known compounds. Many of these toxins are either novel to the ICES region or are not currently monitored, they include regulated and non-regulated groups of compounds. WGHABD will aim to synthesise information on the prevalence of these along with appropriate methods to detect them.</p>	<p>regarding harmful microalgal and cyanobacterial producers to be determined, allowing the identification and better management of risk to human health. During the coming reporting cycle the WG will explore the expansion of toxin risks from known sources and highlight novel toxin detections and detection methods. This links to Science Priorities focussing on Ecosystem Science and Seafood Production and will also feed into the IOC Intergovernmental Panel on HABs (IPHAB) task team on Algal Toxins.</p>			<p>countries along with new toxin detection methods and/or toxic compounds discovered.</p> <p>Yr 3: Produce a short synthesis of current thinking/knowledge within the North Atlantic ICES region for emergent toxins. This will feed into research direction, policy and future HAEDAT recordings/categories.</p>
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 <i>Ecosystem science, Emerging Technologies and Techniques, Observation and Exploration.</i></p>	1.3, 3.3, 4.1	Year 1,2,3	<p>Yrs 1-3 A report on new findings in the area of harmful algal bloom dynamics will appear in the WGHABD science report.</p>
f	<p>Mortalities of both farmed and wild fish are common if episodic events throughout the ICES north Atlantic region. There are also a number of ongoing initiatives (IPHAB Task Team on fish killing microalgae, outputs from GlobalHAB Fish-Killing Algal Events symposium) which are focused on addressing issues of fish killing algae and associated faunal mortality events. Historical records tend to report fish mortalities circumstantially linked to only high biomass algal blooms of “fish-killing”</p>	<p>Food security continues to be a science/strategic priority for ICES, with fish health implications for human consumers of seafood. The specific role of known ichthyotoxins versus non-specific lytic compounds causing gill damage remains to be fully elucidated. The role of harmful phytoplankton as a co-stressor in these circumstances has yet to be investigated. WGHABD will open discussions with WG PDMO to consider comparative overlap on this topic. This ToR relates to ICES</p>	5.6	Year 1,2,3	<p>Yr 1 Review outputs from IPHAB, GlobalHAB Colloquium on Fish Killing Microalgae. Discuss with AQUA SG and align and review options for contributions for ICES Aquaculture Overviews.</p> <p>Yr.2. Open dialogue with WGPDMO to review plankton as a co-stressor for CGD with a view to potential shared or back to back meeting to explore areas of common interest and synergies.</p>

species. The impact of sublethal effects, however, of harmful phytoplankton as multi-stress contributors to fish morbidity, e.g. in complex gill disorders (CGD) of farmed fish has yet to be fully investigated. Delegates will update the WG on progress with external initiatives, and clarify mechanisms for reporting fish mortality events (overlap with HAEDAT ToR c), build communication links and synergy with WG Pathology and Diseases of Marine Organisms (WG PDMO), and contribute to ICES aquaculture overviews.

Yr.3. Potential shared day with WGPDMO to review phytoplankton as a stressor on assessment of CGD. Production of review article based on experiences from both WGs.

8	<p>This ToR will support the implementation of automated observation systems for harmful algal bloom observations to improve early detection and warnings of HABs in the ICES area. Automated samplers are becoming more common in the ICES area however some are still 'novel' technologies. Delegates will share experiences with these new technologies to contribute to the integration of these techniques into HAB monitoring and research programmes.</p>	<p>Early detection of harmful algal blooms is needed for HAB warnings to protect human health, the aquaculture industry etc. Standard methods include manual sampling and microscope analyses of samples. Novel technology, i.e. imaging flow cytometry, is available for automated sampling and automated analysis of plankton composition and abundance. At present three at least different systems are available commercially. An ICES-IOC-SCOR GlobalHAB automated plankton observations symposium planned for June 2020 has been postponed until 2021, this will bring together people working in this new area to consolidate experiences in implementing this technology. These feeds into the <i>Observation and Exploration, Emerging technologies and Techniques</i></p>	3.3, 4.1, 5.6	Year 1,2,3	<p>Yr 1 Report progress with the GlobalHAB automated plankton observations workshop.</p> <p>Yr 2 Report the outcomes of the GlobalHAB automated plankton observations workshop postponed until 2021.</p> <p>Yr 3 Contribution of a chapter to an Ocean Best Practice manual on automated phytoplankton observations using imaging flow cytometry.</p> <p>Produce an overview of experiences of Harmful Algal Bloom observations using imaging flow cytometry.</p>
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		and <i>Seafood Production</i> .			
h	Produce protocols and guidelines for qPCR methodologies for the study and monitoring of HAB species using eDNA	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 <i>Ecosystem Science and Emerging Techniques and Technologies</i> .	1.6, 1.8, 4.4	Year 1,2,3	<p>Yr 1 – review qPCR strategies along with metabarcoding approaches across the ICES countries for the field detection and ecological studies of HAB species.</p> <p>Yr 2 – Organisation of a qPCR meeting with experts outside the WGHABD (PICES etc) to discuss and elaborate common qPCR strategies and protocols (ICHA 2022/2023 Hiroshima, Japan).</p> <p>Yr 3 – Discussion with other ICES WG working groups about the eDNA approaches and presentation of the specificity of the WGHABD strategy.</p> <p><i>For next reporting cycle</i></p> <p>Yr 4 – Production of guidelines and protocols for the ICES area for qPCR methods.</p> <p>Yr 5 – Discussion and feedback from the monitoring systems about the feasibility of the application of the protocols.</p> <p>Yr 6 – Organisation of a practical qPCR workshop to show the chosen protocols.</p>
i	To ensure the WG's visibility and the promotion of its work, a website will be developed and deployed for public access for the purposes of disseminating its activities where it will be updated and further developed on an annual basis. Further media platforms including	WGHABD has close links with IOC and PICES and thus a requirement was identified for promoting and disseminating the outputs of the Working Group and to have a visible presence on a number of media platforms where users can access information relating		Year 1,2,3	<p>Yr 1. Discuss with ICES options around website, which is envisaged to be developed through Marine Institute, Ireland. Ensure relevant links to ICES and IOC are included.</p> <p>Yr 2 Deploy webite and review material to be</p>

social media will be looked at as further vectors as pathways for information dissemination. WGHABD will liaise with ICES throughout with links to the ICES sharepoint WGHABD webpage. The website will be used as a portal and will have links to data products from HAEDAT (ToR C) as well as other ICES and IOC sources	to the group activities, monitoring stations, research and publications all in one place. This is will be an important promotion of the work of ICES-IOC WGHABD and links with other scientific bodies and panels such as IOC UNESCO, SCOR GlobalHAB and more. This feeds into the vision and mission of of ICES through the provision of information, advice and guidance.	included on website. Yr 3 Update website and review activity.
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Summary of the Work Plan

Year 1	Present national reports, new findings and update HAEDAT database. Review the role of environmental drivers on benthic HABs in the ICES area. Review HAEDAT reporting forms and report to IOC with recommendations. Update WG on emerging toxins and report on external initiatives focused on fish killing microalgae. Report on progress with workshop on automated imaging technologies and review molecular methodologies used for the detection of HABs within the WG. Develop WGHABD website.
Year 2	Present national reports, new findings and update HAEDAT database. Report new findings about the diversity and distribution of HAB species in the Arctic. Identify time series of phytoplankton counts and toxicity data to support HAEDAT data and products. Open dialogue with WG PDMO to discuss activities around CGD. Report progress with automated imaging workshop. Organise qPCR methodologies meeting with external partners to discuss approaches and protocols for qPCR methodologies. Deploy WGHABD website.
Year 3	Present national reports, new findings and update HAEDAT database. Review potential of sedimentary eDNA to inform on impacts of climate change on HABs. Review products from HAEDAT and presentation at ICHA conference in 2023. Produce document on status of emerging toxins in the ICES area. Contribution to Ocean Best Practices Manual on automated imaging technology. Discussion with other ICES WGs about their eDNA strategy. Potential shared day with WG PDMO about role of phytoplankton in CGD.

Supporting information

Priority	Hamrful algal blooms can negatively impact ecosystems and ecosystem services within the ICES area. ICES-IOC WGHABD are have developed a suite of ToRs that address the rising issues associates with HABs in the North Atlantic. The current activities of WGHABD address multiple science priorities within ICES. These are Ecosystem Science, Observation and Exploration, Emerging Techniques and Technologies, Seafood Production and Conservation and Management Science. In addition WGHABD is also involved with a number of global initiatives via the IOC Intergovernmental Panel for HABS and the IOC Global HAB Status Report which is placing ICES Science on a global stage.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. Some countries have not attended in recent years due to limiting resources.

Participants	WGHABD is normally attended by some 20–25 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	Output from HAEDAT and ICES Harmful Algal Event Status report will provide material for ACOM should requests for advice require consideration of impacts from HABs.
Linkages to other committees or groups	There is a working relationship with WGPME, WGZE, WGITMO and WG BOSV. During the coming reporting cycle linkages with WG PDMO will be strengthened and relationship with the Aquaculture Steering group enhanced.
Linkages to other organizations	WGHABD is co-sponsored by the IOC and works closely with it under a number of HAB initiatives.

Working Group on Oceanic Hydrography (WGOH)

2020/FT/EPDSG05 The **Working Group on Oceanic Hydrography (WGOH)**, chaired by Caroline Cusack, Ireland; and Tycjan Wodzinowski, Poland, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	13–15 April	Online meeting	Interim e-evaluation	
Year 2022	11–12 April; 19 April	Online meeting	Interim e-evaluation	
Year 2023	21–23 March	Hybrid meeting Woods Hole, US	Final report by DATE to SCICOM	

ToR descriptors

ToR	Description	Background	SCIENCE PLAN TOPICS ADDRESSED	Duration	Expected Deliverables
A	Examine the hydrographic variability of the North Atlantic and its subpolar seas. Identify events, trends and drivers in the region.	The experts of the WGOH will compile a wide range of observations taken by various national programmes. This exercise helps to monitor developments of the environmental conditions that they sample.	1.1; 1.2; 1.9	3 years	Annual WGOH meeting featuring a series of regional presentations, covering evolution of hydrographic conditions and development of monitoring programmes. The synthesis of these changes are summarised in our annual science report.
B	Standard Sections and Stations summarized into the production of the IROC report and IROC-online web https://ocean.ices.dk/core/iroc	The Working Group recognises the need to disseminate climate information in a timely and appropriate manner. IROC content and structure is	1.1; 1.2; 1.9	Years	i) A summary of data Series are uploaded, as they become available, to IROC online web. ii) IROC Highlights available 1-2 weeks after the WGOH annual meeting, summarizing conditions in the previous year.

		revised every year. Improvements are proposed and implemented when possible.			iii) IROC report published as an ICES CRR document. Target: Release in summer, before the ASC.
C	Explore and continue to increase the international profile and exposure of this EG across national and international events and engagement with the broader ocean observing system community (e.g. GOOS).	Participate in and/or organise national and international events. For example, the WGOH organised the 1991, 2001 and 2011 joint ICES/NAFO 4th symposium and will organise the 2021 decadal event. Benefit both to ICES and international monitoring programmes to enhance information exchange. Need for further connections between hydrographic monitoring programmes involved with WGOH and the GOOS community was highlighted as a critical issue to address. Contact has been established with OceanOPS (formerly JCOMMPS) and should be maintained.	1.2; 1.9; 4.2	3 years	EG members will publish in the proceedings of suitable events (e.g., the ICES/NAFO 4th Joint Symposium on Decadal Variability of the North Atlantic and its Marine Ecosystems). Outcomes of engagement activities with the broader ocean observing system community are documented as part of 3rd year progress, connecting WGOH metadata and data links with OceanOPS is a WGOH target for the term.
D	Support for ICES processes on hydrographic data and ocean scale marine climate variability. Including Data Centre, other EGs, requests by the parent steering group EPDSG (Ecosystem Processes and Dynamics Steering Group) and advice programme as required.	Oceanic hydrography remains a fundamental component of assessing the state of marine ecosystems. WGOH documents interannual to multidecadal variability and trends in the oceanic hydrography for most ecoregions. WGOH can provide expert advice to ICES in relationship to observing systems (GOOS), CMEMS (Copernicus Marine Environment Monitoring Service) or policy (MSFD, Marine Strategy Framework	1.1;1.2; 1.9; 6.3	Ongoing	Delivery of timely data and advice, upon ICES request or by WGOH initiative in developments that depend on ocean hydrography (Ecosystem Overviews, ICES Oceanography Review etc). Assessment on ocean hydrography related issued upon request.

Directive).

Summary of the Work Plan

Year 1	<p>a) Symposium on Decadal Variability preparation and celebration.</p> <p>b) IROC 2020 production including early release of highlights of North Atlantic hydrographic conditions. Review the current roadmap for IROC evolution. Implement modifications to IROC format and content as feasible.</p> <p>c) WG Activities progress report including status of WGOH timeseries and update on linkages with the broader community (e.g., oceanographic, policy).</p> <p>d) Review climate monitoring, reanalysis and forecasting programmes relative to ICES work.</p>
Year 2	<p>a) IROC 2021 production including early release of highlights of North Atlantic hydrographic conditions. Implement modifications to IROC format and content as feasible.</p> <p>b) Publication of IJMS Decadal Symposium special issue.</p> <p>c) WG Activities progress report.</p>
Year 3	<p>a) IROC 2022 production and review of content and requirement to continue IROC process.</p> <p>b) WG Final report</p>

Supporting information

Priority	Oceanic hydrography remains a fundamental component of assessing the state of marine ecosystems. WGOH documents interannual to multidecadal variability and trends in the oceanic hydrography setting the vital context for prevailing conditions & ecosystem change. The IROC has been cited more than 220 times (http://tinyurl.com/ICES-IROC) demonstrating that it is an important resource for the marine science community within and beyond ICES.
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 about 15–20 members and guests.
Secretariat facilities	Support required to publish the IROC.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages. The group is open to requests regarding environmental policy.
Linkages to other committees or groups	There is a very close working relationship with all the groups of EPDSG. The most direct link is to WGOOFE (Working Group on Operational oceanographic products for fisheries and environment) where the activities of the 2 groups are complementary. WGOH focuses on the larger Atlantic space and long-term climate scales. Link to ICES editorial team for the annual production of the IROC.
Linkages to other organizations	IOC, JCOMM, CLIVAR?, GOOS

Workshop on Scallop Aging 2 (WKS2)- postponed to 2023

2020/WK/EPDSG06 The **Workshop on Scallop Aging 2 (WKS2)**: on age reading of the king scallop (*Pecten maximus*), chaired by Karen Vanstaen, UK; and Charlotte Reeves, UK, will hold an online meeting on 20 October 2021, and will meet in Lowestoft, UK, 7–8 March 2023 to:

- a) Create, collate and consensus age a reference collection of scallop shells for the participating institutes across geographical fishery locations ([Science Plan code: 3.1](#))
- b) Carry out microscope aging QC consensus training ([Science Plan code: 3.1](#))
- c) Further progress the use of SmartDots technology for virtual aging king scallops ([Science Plan code: 4.1](#))
- d) Agree quality assurance parameters for scallop aging ([Science Plan code: 3.1](#))
- e) Review new and evolving methodologies in scallop age techniques ([Science Plan code: 3.1](#))
- f) Maintain a regular platform to progress information flow and develop consistent shell aging ([Science Plan code: 3.1](#))
- g) Discuss the potential of applying similar age determination techniques to other scallop species in particular *Aequipecten opercularis* ([Science Plan code: 4.1](#))

WKSA2 will report by 1 June 2023 for the attention of WGScallop, WGBIOP and SCICOM.

Supporting information

Priority	<p>The fundamental progress made in the inaugural scallop aging workshop recommended the completion of consensus aging of reference sets and further training exchanges for aging activities.</p> <p>Issues around aging consensus are considered with very high priority due to their requirement to contribute to accurate fishery and stock assessment processes.</p> <p>Further scallop exchanges depend on the completion of reference sets and consensus aging, therefore the key aim for the meeting.</p>
Scientific justification	<p>The aim of the workshop is to build on progress made and complete a consensus aging of reference sets for each institute.</p> <p>To also maintain and develop connectivity in aging techniques and understanding between institutes, exploring new techniques and adding to previously defined standard principles of agreed attribute that provide a more robust aging procedure.</p>
Resource requirements	<p>It will be expected that each institute would bring reference sets from important geographical locations to the meeting for aging purposes. Otherwise, no further specific resource requirement beyond the need for members to prepare and participate in the meeting.</p>
Participants	<p>In view of its relevance to the data collection process and ICES Scallop WG, the workshop will join international experts on growth, age estimation and scientists involved in assessment in order to progress growth and connectivity in the field.</p> <p>The workshop is normally attended by some 20–25 members from United Kingdom, France, Norway, Ireland, Iceland, United States and Canada.</p>
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the advisory committees.
Linkages to other committees or groups	There is a close working relationship with all the groups of the WGScallop and WGBIOP
Linkages to other organizations	There is a direct link with the EU DCF.

Joint ICES/ PICES Working Group on Ocean Negative Carbon Emission (WGONCE)

2020/FT/EPDSG07 A Joint ICES/PICES Working Group on Ocean Negative Carbon Emission (WGONCE), chaired by Louis Legendre, France (ICES), Carol Robinson, UK (ICES) and Nianzhi Jiao, China (PICES), Douglas Wallace, Canada (PICES) will be established and will work on ToRs and generate deliverables as listed in the Table below.

YEAR	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	24 September	Online meeting	Interim e-evaluation	
Year 2022	7 November	Online meeting	Interim e-evaluation	
Year 2023	October	TBD	Final report by DATE December to SCICOM	

ToR descriptors

ToR	Description	Background	SCIENCE PLAN CODES	Duration	Expected Deliverables
a	To identify current knowledge gaps in negative carbon emission in the inshore and offshore oceans, and propose new research directions linking scientific research and its applications to the enhancement of negative carbon emissions.	The 2018 IPCC assessment has stressed the importance of negative emissions in order to limit the global warming to 1.5°C.	1.3, 1.9	3 years	Production of a review paper
b	To produce a plan to support the development of additional long-term time series stations for the observation of carbon sequestration in representative coastal and offshore waters	Long-term time series observation in representative coastal and offshore waters is necessary for our understanding of carbon sequestration in the ocean.	3.1, 3.2, 3.3	3 years	Compilation on a data management plan
c	To propose integrated experimental studies for process and mechanism of carbon sequestration under paleo-, current and future oceanic conditions	Marine carbon sequestration varied in paleo-, current and future conditions.	1.3, 7.6	3 years	This information will form the basis of research papers

Summary of the Work Plan

Year 1	Meetings to address Ocean Negative Carbon Emission knowledge gaps and plan the long term time series stations.
Year 2	Propose, develop and start with a direct methodology to support integrated experimental studies

Year 3

Meetings to review the progress and write review/research papers

Supporting information

Priority	The ICES Science Plan prioritises work on biogeochemical cycles and monitoring and climate change is a core strategic and cross-cutting issue for ICES as co-ordinated by the Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME). There are growing societal and policy needs for information on Negative Carbon Emission and the work of this group will help to address this evidence need. Current activities of this Group will lead ICES into issues related to the global climate change, especially with regard to the role of ocean in the global carbon sequestration. 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 expected to be attended by some 20–25 members and guests.
Secretariat facilities	Standard support
Financial	None
Linkages to ACOM and group - under ACOM	
Linkages to other committees or groups	Ecosystem Observation Steering Group, Data and Information Group
Linkages to other organizations	UNEP, UNESCO, IMBeR

Working Group on Zooplankton Ecology (WGZE)

2020/FT/EPDSG08 The Working Group on Zooplankton Ecology (WGZE), chaired by Sophie Pitois, UK, and Lidia Yebra, Spain, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	22–25 February	Online meeting	Interim e-evaluation	
Year 2022	20–23 June	Online meeting	Interim e-evaluation	
Year 2023	27-30 March	In person meeting Napoli, Italy	Final Report by DATE to SCICOM	

ToR descriptors

ToR	Description	Background	SCIENCE PLAN CODES	Duration	Expected Deliverables
A	Review the suitability of	Zooplankton time-series are an important tool in the	1.3, 2.5, 6.3	Years 1-3	Inventory of variables

	existing zooplankton time-series data in the ICES area to develop indicators addressing global biodiversity conservation challenges and ecosystem functioning.	development of indicators addressing global biodiversity conservation challenges, by this contributing to the international biodiversity conservation frameworks and ecological assessments. In the past, zooplankton data have rarely been used for conservation and management of marine ecosystems and services they provide. However, they could effectively contribute to the development of zooplankton indicators, which would fill in gaps in the regional and global assessments. The basis to effectively utilise zooplankton data in decision making on the ecosystem health of the ocean includes common data sharing protocols among existing regional zooplankton monitoring programs to ensure quality-controlled data on a global scale.			recorded in the existing zooplankton time-series in the ICES area Identification of gaps in ongoing monitoring programs with respect to the variables recommended to serve as basis for the development of ecological indicators Recommendations for future monitoring strategies that support the development of biodiversity indicators.
B	Assessing changes and trends of zooplankton community properties.	Zooplankton community structure and production are strongly influenced by ocean circulation and environmental conditions (e.g., water column mixing and water temperature), which have been changing significantly over the last few decades. Changes in zooplankton communities have been observed at sites across the North Atlantic, but the common or contrasting patterns of community change have not yet been fully assessed across WGZE time-series stations at the basin scale. This ToR will explore long-term data on the distribution (spatial and temporal), abundance, composition, and species diversity of zooplankton in the ICES regions. In addition to the traditional mesozooplankton, this work will look at changes in the macrozooplankton, microzooplankton, and gelatinous zooplankton communities. (Through its collaborative work with WGPME and the ICES Plankton Status Report, elements of the phytoplankton and microbial plankton community may also be considered). Tracking and understanding changes in zooplankton community composition across time series stations and at the basin scale has applications to understanding the inter-connection of pelagic systems and their potential management and preservation.	1.3,1.4,1.9	Years 1-3	Update content (additional years, new summaries, new time series site) in the WGZE/WGPME time-series metabase (https://wgze.net/time-series) Publication of the ICES Plankton Status Report, and submission of an ICES JMS article introducing and summarizing its key findings Peer-reviewed publication on changes in species-level rank and composition changes in the ICES area.
C	Compile data on zooplankton key traits in the ICES area and continue development of the WGZE Zooplankton Biometric Atlas.	Zooplankton individual traits (e.g., average size and carbon content, herbivore vs predator, respiration and fecundity rates), and understanding how environmental factors structure zooplankton communities and affect their functioning are key components to predict potential zooplankton community reorganizations under changing environmental conditions. A database allowing the systematic analysis of zooplankton trait distributions along various environmental gradients in physical parameters, primary productivity or nutrient concentrations increases the mechanistic understanding of the structure and function of zooplankton communities. An integration of zooplankton traits measured and collected at different monitoring sites represented in the WGZE, as well as already available online databases, will be an	1.7, 2.2, 2.5	Years 1-3	A peer reviewed publication based on a comprehensive database of zooplankton traits and physiological rates to present an exhaustive state of the art and highlight key gaps in our knowledge in this field.

		important tool in the analysis of zooplankton traits along various environmental gradients. It will also provide an important resource for potential future developments of ecosystem models that explicitly represent zooplankton physiology in order to predict the role of oceans in global climate regulation.			
D	Review of plankton sampling and analytical methodologies with emphasis on emerging methods in image analysis and machine learning.	Methods of automated plankton identification are recognised for benefits brought to the study of zooplankton in the field and laboratory. Field applications include in-situ measurements and capturing information on spatial distributions of zooplankton. In the laboratory, characterisation of zooplankton communities can be very time consuming, costly and requires a high level of training. Increasing demands for zooplankton data, under a climate of diminishing budgets for monitoring, has driven the development of cost-effective technologies. The use of image analysis combined with identification algorithms used in machine/deep learning and artificial intelligence is a rapidly growing field of research and can have a direct impact on the rate at which changes in zooplankton communities can be evaluated. This ToR will build on previous WGZE work intended to provide advice about identifying new tools to be applied for ICES zooplankton monitoring sites.	4.1, 4.4	Years 1-3	Literature review on the progress in development of software / hardware for “automatic” identification List of software tools and identification methods used in different laboratories within the ICES area A document listing the main challenges/ bottlenecks faced by zooplankton researchers in moving forward A table identifying potential problems and solutions in the use of different tools applied to monitoring of zooplankton communities A peer-reviewed publication highlighting the new tools in this field, which may be applied in zooplankton monitoring at ICES sites.
E	Development of zooplankton outreach and training.	Outreach activities in WGZE are extremely important to connect between all people working on zooplankton in the ICES area, bringing knowledge and expertise within the group but, primarily, transferring it to other scientists in the ICES community and to the general public. This is clearly connected with the present ICES Science Plan as one of the outcomes is to have marine science with a high and beneficial impact on society. On the other hand training is becoming more and more a necessity through the zooplankton science community, especially in terms of assessing biodiversity and integrative identification of plankton species that are key issues for all ecology studies. This ToR will support the editors of the ID Leaflets for Plankton, to continue the organization of the Zooplankton Production Symposium and the development of theme sessions for the ICES ASC within the WGZE community.	1.2, 1.4, 1.6	Years 1-3	Updated Taxonomic Leaflets uploaded to the web page. Preparation and organisation of theme sessions of the next Zooplankton Production Symposium Submission of theme sessions to the ICES ACS Collaboration with other EGs on the organization of training courses on zooplankton and linking to the ICES Training Course Scheme.
F	Design and carry out coordinated and collaborative activities with other EGs.	Synergy is expected based on development of the common activities strategy with WGIMT, WGPME, WGACEGG, WGIPEM, WGSPP and WGWEAWESS.	1.6, 5.2	Years 1-3	Plan of activities to be developed and evaluated during the 3 years, as the EG keeps seeking new collaborations.

Summary of the Work Plan

Year 1	All ToRs, review available information, define way forwards from discussion among group
Year 2	Integrate all information/data gathered
Year 3	Output: reports, peer-reviewed publications, etc.

Supporting information

Priority	<p>The current activities of WGZE will continue along the main priority within WGZE ToRs: long-term series, trends and climate change, zooplankton community structures, functioning and properties; distribution and indicators for policy directives, ecosystem modelling, and outreach activities; the application of the latest technologies for the monitoring of zooplankton; and finally outreach and collaborative activities with other ICES expert groups.</p> <p>The WGZE work and ToRs are aligned with the ICES Science Programme and are of high priority. The WGZE are active contributors and aim to report their outcomes directly to ICES in their annual report, Plankton Status Report, Ecosystem Overviews, ICES ASC, and in parallel as peer reviewed literature.</p>
Resource requirements	Group contribution
Participants	The group is normally attended by 20-30 members and chair-invited guests
Secretariat facilities	Standard support
Financial	None
Linkages to ACOM and groups under ACOM	No obvious direct linkages
Linkages to other committees or groups	WGIMT, WGPME, WGACEGG, WGIPEM and WGSPP.
Linkages to other organizations	OSPAR, IGC-COBAM

Working Group on Resilience and marine ecosystem services (WGRMES)

2020/FT/EPDSG09 The Working Group on Resilience and Marine Ecosystem Services (WGRMES), chaired by Andrea Belgrano, Sweden; Yajie Liu, Norway; and Pablo Pita, Spain; will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	23–26 November	Online meeting	Interim e-evaluation	
Year 2022	21–25 November	ICES HQ	Interim e-evaluation	
Year 2023	5-8 September (tbc)	Spain (tbc)	Final report by DATE to SCICOM	

ToR descriptors

ToR	Description	Background	Science Plan Codes	Duration	Expected Deliverables
A	To document resilience of marine ecosystem services by using case studies in Europe at different scales (local, regional, national).	Information, data and evidence on resilience and marine ecosystem services (and nature contribution to people) are scarce and not organized. Links to ICES Science Plan 1st, 2nd and 3rd thematic areas, and WGs described above.	1.3; 2.1; 2.4	3 years	-Interim report -Public online repository of data/case studies. -Special Session at ICES Conference
B	To review and document multidimensional valuation of marine ecosystem services.	Valuing marine ES is key for policy makers. This task will be directly linked with the IPBES Global Multiple Values Assessment and the IPBES Global Nexus Assessment. Links to ICES Science Plan 1st and 2nd Thematic Areas; and WGs described above.	3.6; 6.1; 6.5	3 years	-Interim report -A review paper on multidimensional values of marine ecosystem services -Special Session at ICES Conference
C	To document and analyse transformative changes of marine social-ecological systems towards ocean equity.	Document fundamental changes (including property rights, management systems and Marine Protected Areas) which facilitate transformations of social groups. Links to ICES Science Plan 1st, 2nd and 3rd thematic areas, and WGs described above and below. This task will be directly linked with the IPBES Global Transformative Change Assessment, and the Strategic Initiative on the Human Dimension, and the High-Level Panel for a Sustainable Ocean Economy.	6.4; 6.5; 7.4	3 years	-Interim report -A review paper -Database with marine seeds for a good Anthropocene linking marine social-ecological information -Special Session at ICES Conference -Special Issue about Ocean Equity

Summary of the Work Plan

Year 1	Document and review of existing conceptual frameworks, methodologies and tools to analyse and operationalize resilience to monitor sustainability of marine ecosystem services
Year 2	Understand the role of tangible and intangible benefits of the oceans to human well-being from fisheries and aquaculture sectors and their associated value chains.

Year 3	Document and review transformative changes of marine social-ecological systems, including commercial and recreational fisheries, and aquaculture. Provide a better understanding on how fisheries resources, governance institutions and actors learn and respond to diverse drivers of climate change and other human-induced drivers, as well as to design policies and actions aimed at building resilience. Review what plausible pathways exist for achieving the UN 2030 SDGS and the 2050 Vision for Biodiversity.
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Supporting information

Priority	Very high. The current activities of this Group will lead ICES into issues related to marine ecosystem services, integrating fisheries management and transformative changes towards ocean equity. 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. The WGREMS will explore to get funds from H2020 calls and others to support and expand the activities inside and outside Europe
Linkages to ACOM and group under ACOM	AFWG, WGRFS.
Linkages to other committees or groups	There is a close working relationship with WGBIODIV, WGECON, WGSOCIAL, WGMHM, WGMPCZM, WGSFD, WGISUR, WGMARS, WGECON and SICCME.
Linkages to other organizations	The work of this group is aligned with other global nodes of ES research such as the IP-BES, Future Earth and the Ecosystem Services Partnership. The work is also in line with the Natural Capital Project (http://www.naturalcapitalproject.org/), ++ and numerous scientific and regulatory governmental and university's departments in ICES countries.

EGs dissolved in 2022

Res. Code	EG Name	Chairs
2021/WK/EPDSG08	Workshop on Stickleback and Round Goby in the Baltic Sea (WKSTARGATE)	Jane Behrens, Denmark and Daniel Oesterwind, Germany