

## **Ecosystem Processes and Dynamics Steering Group EGs Resolutions**

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## Resolutions approved in 2021

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### 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.*

**2021/OT/EPDSG01** The **Working Group on Marine Mammal Ecology (WGMME)**, chaired by Sophie Brasseur\*, the Netherlands; and Peter Evans\*, UK; will meet online, 7–10 February 2022 to:

- a) Review and report on any new information on seal and cetacean population abundance, distribution, population/stock structure in the North Atlantic (including North Sea and Baltic Sea), including information on 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 North Atlantic (as defined above)
- c) Review and report on any new information on seal and cetacean and anthropogenic threats (including cumulative effects) to individual health and population status in the North Atlantic
- d) In collaboration with WGBIODIV, identify foraging areas and estimate prey consumption by harbour seal, grey seal and harbour porpoise in the North Sea case study area
- e) In collaboration with WGBYC contribute to the [Roadmap for ICES PETS bycatch advice](#) by reviewing selected aspects of marine mammal-fishery interactions and assembling data and qualitative information available from other sources not fully covered by WGBYC (notably strandings) on marine mammals.

WGMME will report by 11 March 2022 (via EPDSG) for the attention of ACOM and SCICOM.

### Supporting Information

Priority	The activities of this Group contribute to the understanding of the ecological role of marine mammals
Scientific justification	<p>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. Theoretical frameworks and approaches for assessing cumulative effects of multiple stressors were reviewed in 2019 but new information can be provided.</p> <p>ToR d aims to review species-specific foraging distributions (considering horizontal and vertical dimensions depending on data availability) and estimate consumption by marine mammal species representative in case study areas. ToR d has been agreed between WGMME and WGBIODIV to support WGBIODIV's ToR "<i>Investigate mechanisms linking trophic guilds under contrasting levels of pressure and/or primary production in case study areas</i>".</p> <p>ToR e reflects common interests between WGMME and WGBYC, recognising that 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.</p>
Resource requirements	None
Participants	The Group is expected to be attended by 15–20 members.
Secretariat facilities	Web conference
Financial	None

Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGBYC, WGHARP, WGBIODIV, WGSAM, SCICOM
Linkages to other organizations	OSPAR, HELCOM, ASCOBANS; IWC

### 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/JWGBIRD%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		
Year 2023				
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 scales that meet international strategies and directives (e.g. OSPAR, MSFD). The approach to understanding ecosystems using complementary	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 and policy, e.g. maps showing biodiversity patterns in space and

		<p>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>			change over time delivered through WG report.
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 thus be particularly effective (2.2, 2.3).</p>	2.1	3 years	Literature review of threshold responses across realms, habitats, ecosystem components (do biodiversity thresholds exist?)
			2.2	3 years	Compile relevant data sets across ecosystem components (benthic invertebrates, plankton, fish, elasmobranchs, mammals)
			2.3	3 years	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.
c	Examine the efficacy of spatial protection measures to	The United Nations Sustainable Development Goal 'to 'Conserve and sustainably use the oceans, seas and	3.1; 3.2; 3.3	3 years	Production of peer reviewed paper and/ or conference paper. Evidence for ecosystem management

conserve and protect biodiversity and meet wider aims (ecosystem function and services).	<p>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 (<a href="#">EcoStar</a>, <a href="#">FuECoMMS</a>, <a href="#">DREAMS</a>; 3.3).</p>	and policy, e.g. biodiversity status, trends and threats (inc. cumulative pressures and evolving energy infrastructure) in areas of interest, delivered through WG report.
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### 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.

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Linkages to other organizations                      OSPAR, HELCOM, European Commission

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### 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	13–15 June	online		
Year 2023				
Year 2024			Final report by DATE to SCICOM	

### ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Generate improved knowledge of small food web components that are poorly monitored/assessed	There is a lack of consideration of smaller phytoplankton in monitoring and assessment studies which make up majority of plankton diversity and in some areas biomass. With the advent of flow cytometry, genetics and imaging, small phytoplankton datasets have been collected over a reasonable time series to be useful in ecological studies but many are not available/accessible to the general scientific community. To assist in the use of smaller phytoplankton for ocean studies, we will collate smaller phytoplankton data sources into a database available on WGPME and GLOMICON based on a questionnaire to engage other users.	1.3	3 years	To deliver data on smaller phytoplankton to GLOMICON for improved research access to pico/nano-phytoplankton datasets. Based on the quality/quantity of data collated, we will assess if a synthesis paper could be written.
b	Update on Explore the use of indicators for Knowledge Exchange	Many WGPME members are involved in developing phytoplankton/microbial indicators but at regional levels that can differ in approach and in many cases. This an ongoing process and there are few opportunities to compare approaches or results. Therefore, this	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

		ToR continues from the previous term but the aim changed to an ongoing knowledge exchange activity to guide members new to developing indicators for their region.			topic will be requested from EG members and summary into ICES reports.
c	Conduct an integrated analysis of phytoplankton and microbial plankton responses to global warming.	Understand consequences of long-term changes e.g. in phenology and body size for foodweb functioning and associated eco-system services. This is a continuation of ToR d from the previous term that was delayed due to member change and COVID but still considered an important output. Decision to restart the ToR and start again as time period are out of date. Renewed another 3 years.	1.3; 2.5	Renewed for 3 years	Two research papers on picoplankton and diatom to be written.
d	Produce a guide of key live vs Lugol-fixed key species from existing samples.	To facilitate taxonomy guidance a web-based guide will be produced. Many time-series used Lugols preservative for phytoplankton which alters the morphology of the cells. Other studies use live cells. These can lead to misidentification. There are lack of guides that show both live and preserved cells. This ToR aims to produce a short information card showing pictures of both live and lugols-preserved cells for clearly defined species for each taxon will be a valuable taxonomy guide.	4.4	3 years	A database will be set up based on a standardised template with photographs produced by members to populate. Ultimately it can be published on WGPME website. Depending on the extent of cells, members will discuss whether it will be published in a TIMES report and/or ICES identification leaflet..
e	Analyse trends in occurrence of both phyto- and zooplankton.	Develop an integrated plankton report presenting trends in occurrence of both phyto and zooplankton. Progress made but due to COVID lockdown and computer management changes the report is delayed likely Dec 21/ Jan 22.	1.3; 1.9		Cooperative Research Report on Phytoplankton/ Zooplankton (incollaboration with WGZE).
f	Joint activities with other EGs	North Atlantic barcoding Atlas with WGIMT and to hold a joint session with WGHABD and other EGs at the ASC in 2022 to discuss molecular tools for different ecological questions.	1.7	3 years	Incorporation of phytoplankton DNA barcoding taxa into barcoding Atlas ( <a href="http://www.metazoo-gene.org/atlas">www.metazoo-gene.org/atlas</a> ). If accepted, a special joint ASC session as knowledge exchange.
g	Incorporating and validate new and emerging groups in	Modified ToR from 2020 which was a knowledge exchange ToR to produce a first Records database of new species sighting. This will be a	3.3; 4.1	3 years	By year 3: a template database populated by content on WGPME and/ or

monitoring time-series.	web-based database to assist those members carrying out marine monitoring to validate their identification and as a sharing tool. Very likely an ongoing ToR with a view to promoting its use.	other sites e.g. COPE- PODITE.
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### Summary of the Work Plan

Year 1	Finalize Plankton Status Report (ToR e), databases and continue working with tree year ToRs.
Year 2	Finalize the questionarie on picoplankton sampling and ASC session.
Year 3	Finalize papers on ToR c.

### 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 belong 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		
Year 2023				
Year 2024			Final report by Date to SCICOM	



## ToR descriptors

TOR	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	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 <sub>p</sub> 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

### Scallop Assessment Working Group (WGScallop)

To be submitted (after 2021 meeting)

2021/FT/EPDSG06

### 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	DATE October	Split, HR		
Year 2023	October	Naples, Italy (tbc)		

Year 2024	October	Copenhagen, Denmark (tbc)	Final report by 15 December to SCICOM
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### ToR descriptors

TO R	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Compile and analyse data on the geographical distribution, seasonal patterns and interannual variations of <i>Pseudodiaptomus marinus</i> in European waters.	Since its first record in 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.	1.3; 1.9	Years 1-3	One published peer-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	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

		example as feed for fish larvae or as model organism in ecotoxicology studies.			
c	Molecular and morphological identification of <i>Pseudodiaptomus marinus</i> occurring in different environments in European waters.	The molecular characterisation of <i>P. marinus</i> specimens from different sites can shed 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.	4.4	Years 1-3	Two manuscripts to be submitted by the end of ToR (titles to be defined) 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).

### Workshop on Stickleback and Round Goby in the Baltic Sea (WKSTARGATE)

**2021/WK/EPDSG08 A Workshop on Stickleback and Round Goby in the Baltic Sea (WKSTARGATE)**, chaired by Jane Behrens, Denmark; and Daniel Oesterwind, Germany; will be established and will meet at ICES Headquarters, Copenhagen, Denmark, 23–25 August 2022 to:

- a) Assess the ecological consequences of the shifts in abundance and distribution of sticklebacks and round goby in coastal waters of the Baltic Sea ([Science Plan codes](#): 1.9; 6.1);
- b) Evaluate the ecological, economic and legal boundary conditions for a commercial use of stickleback and round goby ([Science Plan codes](#): 5.4; 7.1).

WKSTARGATE will report by 30 August 2022 (via EPDSG) for the attention of ACOM and SCICOM.

### Supporting information

Priority	Stickelbacks, a native species, and round goby, an alien species, affect coastal fisheries and interact with coastal species like pike and pike perch and migrating species like sprat and herring and thus affecting the ecosystem as well as the coastal fishery.
Scientific justification	<p>Term of Reference a)</p> <p>The change in abundance and distribution has major impacts on coastal ecosystems and subsequently, coastal fisheries. Knowledge has been produced in several projects and initiatives and need to be synthesized to derive a general understanding of the consequences on conservation and management of coastal ecosystem and fisheries.</p> <p>Term of Reference b)</p> <p>Fisheries in different countries are interested in the potential of a commercial fishery on stickelback and round goby. When looking at a potential commercial fishery on round goby an alien species, the question arises if usual harvest strategies apply for a species that is invasive and one objective could be to reduce or even eliminate it in the Baltic.</p>
Resource requirements	The work of the workshop builds on existing projects and initiatives. No extra resources are required.
Participants	We expect 20-30 participants, including scientific experts as well as industry and NGO representatives.
Secretariat facilities	Meeting room, video-conferencing platform.
Financial	No financial implications.
Linkages to advisory committees	The findings of the workshop will feed into the evidence base to inform about effects of changes in coastal species assemblages on the ecosystem and the coastal commercial and recreational fisheries.
Linkages to other committees or groups	There are links to WGBFAS, WGVHES, WGIAB.
Linkages to other organizations	The work of this workshop is linked to HELCOM.

### Working Group on Fisheries-Induced Evolution (WGEVO)

To be submitted (after 2021 meeting)

## 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		
Year 2022				
Year 2023			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 advisory requests on	WGOOFE will distribute among their members	5.3, 6.1,	3 years	Involvement of WGOOFE in ICES



	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.	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		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 ( <a href="http://www.ifado.eu">www.ifado.eu</a> ) 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, WGEAWESS, WGNARS) to start process.
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	<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 assesment 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		
Year 2022	9–13 May	Oristano, Italy		
Year 2023			Final report by DATE to SCICOM	

## ToR descriptors

ToR	Description	Background	<a href="#">SCIENCE PLAN TOPICS ADDRESSED</a>	Duration	Expected Deliverables
A	<b>Long-term benthic series and climate change</b>  To identify methodological issues in long-term series comparability	The need for the BEWG to work on current tools and techniques associated to the understanding 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	<b>Species distribution modelling and mapping</b>  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	<b>Benthos and legislative drivers</b>  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.

	<p>3. To review the development of effective monitoring programmes, e.g. design, techniques, improvements, harmonisation and quality assessments.</p> <p>4. To review the development of new molecular genetic techniques and the application of the methods for biodiversity and environmental assessments.</p>	<p>(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.</p>		<p>Years 1-2</p> <p>Years 1-2</p>	<p>NEW- Review paper</p> <p>NEW- review aper</p>
D	<p><b>Benthic biodiversity and ecosystem functioning</b></p> <p>1. To report on the ongoing case studies to assess ecological responses across sediment gradients.</p> <p>2. To consider new functional indicator needs to support MSFD requirements.</p>	<p>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.</p>	<p>2.2; 2.3; 2.4</p>	<p>Years 1-2</p> <p>Year 1-3</p>	<p>ONGOING-Research paper to report on a selected case study.</p> <p>ONGOING-Viewpoint paper</p>
E	<p><b>Benthic biodiversity and conservation: to review the role of benthic ecology in MPAs</b></p> <p>To review the role of benthic ecology, conservation in relation to ongoing issues (e.g. fisheries, NNIS, etc.) in relation to Marine Protected Areas (MPAs)</p>	<p>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</p>	<p>6.1; 6.2; 6.4</p>	<p>Years 1-3</p>	<p>NEW- Review paper</p>

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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.

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### 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, WGEKO, 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		
Year 2022	14–17 June	Weymouth, UK		
Year 2023			Final report by DATE 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.

ToR	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	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 developed focusing on the	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 attention to fjord regions

	<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>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>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. 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 and unknown sources are</p>	<p>New toxin detection methods are continually in development, this allows new information regarding harmful</p>	1.3, 5.6	Year 1,2,3	<p>Yr 1 &amp;2: Members to update group on emerging toxin discoveries from their countries along with new</p>

	<p>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>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>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” species. The impact of</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 science priority Seafood</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> <p>Yr.3. Potential shared day</p>



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.

Production and is of relevance to the Aquaculture Steering Group.

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 and Seafood Production</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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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 relevance 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 social media will be looked at as further vectors as	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 to the group activities, monitoring stations,		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 website and review material to be included on website.</p>

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	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 ICES through the provision of information, advice and guidance.	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		
Year 2022	11–12 April; 19 April	Online meeting		
Year 2023			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 <a href="https://ocean.ices.dk/core/iroc">https://ocean.ices.dk/core/iroc</a>	The Working Group recognises the need to disseminate climate information in a timely and appropriate manner. IROC content and structure is revised every year.	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. iii) IROC report published as an

		Improvements are proposed and implemented when possible.			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 Directive).	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.

## 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 ( <a href="http://tinyurl.com/ICES-IROC">http://tinyurl.com/ICES-IROC</a> ) 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 (WKS A2)

**2020/WK/EPDSG06** The **Workshop on Scallop Aging 2 (WKS A2)**: 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, spring/ summer 2022 (tbc) to:

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

WKS A2 will report by 1 September 2022 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		
Year 2022	October	TBD		
Year 2023	October	TBD	Final report by DATE December to SCICOM	

### ToR descriptors

ToR	Description	Background	<a href="#">SCIENCE PLAN</a> <a href="#">CODES</a>	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 <b>Ocean Negative Carbon Emission</b> 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		
Year 2022	tbc	tbc		
Year 2023			Final Report by DATE to SCICOM	

## ToR descriptors

ToR	Description	Background	<a href="#">SCIENCE PLAN CODES</a>	Duration	Expected Deliverables
A	Review the suitability of existing zooplankton time-series data in the ICES area to develop indicators addressing global biodiversity conservation challenges	Zooplankton time-series are an important tool in the 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	1.3, 2.5, 6.3	Years 1-3	Inventory of variables recorded in the existing zooplankton time-series in the ICES area Identification of gaps in ongoing monitoring

	and ecosystem functioning.	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.			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 ( <a href="https://wgze.net/time-series">https://wgze.net/time-series</a> )  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 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	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.

		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, WGSPF 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

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Year 3                      Output: reports, peer-reviewed publications, etc.

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### Supporting information

Priority	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.  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.
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 WGSPF.
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		
Year 2022	5-8 September (tbc)	Norway (tbc)		
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 analyze 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 analyze 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 ( <a href="http://www.naturalcapitalproject.org/">http://www.naturalcapitalproject.org/</a> ), ++ and numerous scientific and regulatory governmental and university's departments in ICES countries.

## Resolutions approved in 2019

### Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT)

2019/FT/EPDSG01 The Working Group on Integrated Morphological and Molecular Taxonomy (WGIMT), chaired by Elaine Fileman, UK, and Jasmin Renz, 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 2020	27 March	by corresp/ webex		physical meeting cancelled - remote work
Year 2021	26 February	Online meeting		
Year 2022	tbc	tbc	Final report by DATE to SCICOM	meeting in association with WGZE

### ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Evaluate the potential of molecular and morphological approaches for understanding zooplankton 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. Standardized protocols for assessment of pelagic biodiversity are needed to fulfil requirements defined in the Marine Strategy Framework Directive (MSFD). There is a need for inter-comparison of results to understand the impact of protocol choice. A range of molecular approaches, e.g., barcoding and metabarcoding, environmental DNA (eDNA), or proteomic approaches can be adopted to help to address some of the key applications of integrative taxonomy.	1.6; 1.7	year 1,2,3  Year 2  Year 1,2,3	Review the current methods for integrative morphological and molecular taxonomy and evaluate the impacts of choosing different protocols.  Construct an overview of case studies utilizing combined molecular and morphological approaches in zooplankton taxonomy.  Compile a list of challenging zooplankton taxa which will include a top-ten list of zooplankton species complexes in the ICES area (including hidden diversity associated with cryptic, rare, and invasive species and species delimitation).
b	Continue development and enhancement of the WGIMT Resource Portal	Locating and accessing morphological and molecular taxonomic information can be difficult: classical taxonomic references are often	1.6; 1.7	Year 1	Create a glossary of molecular taxonomy terms.  Review and update the online WGIMT overview

		out-of-print or in a non-digital format; many molecular data are not released prior to publication; and a broad variety of methodologies and approaches exist, possibly overwhelming potential new comers to the field. The WGIMT Resource Portal will provide 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.		Year 1,2,3  Year 2  Year 3	materials and resource links.  Create an overview summary and reference-links to meta-barcoding primer protocols.  Update the WGIMT literature library, adding key-words indices.
c	Initiate and support provision of standards, training materials, and taxonomy workshops	Lab exchanges and workshops, including ICES Taxonomy Workshops, are very 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 SCICOM EGs will increase impact and likelihood of adoption for advisory applications.	1.6; 1.8	Year 1,2,3  Year 2,3  Year 1,2,3	Ensure provision of training materials through the WGIMT resource portal, linking to ToR b)  Design, organize and offer lab exchanges and integrative taxonomy workshops  Promote best practices for DNA barcoding and metabarcoding of zooplankton
D	Continue to demonstrate leadership in promoting and encouraging use of integrative taxonomic approaches for assessment of pelagic biodiversity	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. 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.	1.6; 1.7; 1.8	Year 1,2,3  Year 1,2,3	Organize & promote special sessions at national and international conferences: e.g. ICES ASC; ASLO/TOS Ocean Sciences Meetings.  Publish peer-reviewed scientific papers on topics central to the WGIMT mission  Publish peer-reviewed scientific papers on topics central to the WGIMT mission. To include two targeted review papers on 1) The crossover from microscopy to genes in marine diversity, illustrating the transition from traditional morphological species



identification using an integrated approach to full molecular genetic identification of marine plankton communities, demonstrated on marine pelagic copepods as model taxa; 2) Zooplankton biodiversity assessment by molecular methods.

### Summary of the Work Plan

Year 1	Review and evaluate protocols available to promote and accelerate use of state-of-the-art molecular approaches for biodiversity assessment and applications for management and assessment goals (ToR a). Review and update all areas of web portal (ToR b).
Year 2	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 (ToR c).
Year 3	Recommend, encourage, and enable use of integrated morphological and molecular taxonomic analysis of zooplankton in integrated ecosystem assessments in ICES area seas (ToRs a, b).

### Supporting information

Priority	The activities of this Working Group 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	No additional resources are requested or required for planned activities.
Participants	This Expert Group now includes 50 members from 17 countries, and has a balanced representation among experts in morphological and molecular taxonomic approaches and covering a good range of taxonomic groups and ICES geographic regions. The group's annual meeting is normally attended by some 17-20 members and guests. New members are welcome.
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 and is pursuing additional partnerships (e.g., WGPME), while promoting and supporting integrated morphological and molecular taxonomy science for the benefit of the ICES science and advisory communities as a whole.
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)

**2019/FT/EPDSG02** The Working Group on Cephalopod Fisheries and Life History (WGCEPH), chaired by Ana Moreno, Portugal; Daniel Oesterwind, Germany; and Graham Pierce, 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 2020	2–5 June	by corresp/ webex		physical meeting cancelled - remote work
Year 2021	8–11 June	Online meeting		
Year 2022	13–16 June	Teneriffe, Spain	Final report by 1 September to SCICOM	

### ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Report on cephalopod fishery status and trends: update, quality check and analyse relevant fishery statistics (landings, directed effort, discards and survey catches).	A core ToR of WGCEPH since the inception of the group. It provides an overview of the current status of cephalopod fishing in the ICES area.	5.1, 5.2	Years 1-3	Fishery status reports (Annual)
b	Review relevant advances in stock identification, stock assessment methods (e.g., use of environmental predictors, development of Management Strategy Evaluation) and fishery management measures. Conduct preliminary assessments of the main cephalopod stocks in the ICES area, based on trends and/or analytical methods <i>inter alia</i> to support the needs of the MSFD reporting.	While catching cephalopods in large-scale fisheries in the EU is essentially unregulated, fishing pressure is increasing. There is a need to to define stocks / management units. Annual assessments will help to identify threats to stock status and are also relevant for MSFD descriptor 3; review of possible management measures will support formulation of advice, should this become necessary.	5.1, 5.2, 6.1	Years 1-3	Stock status reports (Annual);  Review of current cephalopod fishery management in the ICES area and possible future options (Y1)
c	Continue to review advances in knowledge of life history and ecology, identifying knowledge gaps and research priorities.	Cephalopods show high variation individual life history and population abundance; understanding this variation is essential to underpin assessment and management. In relation to the ecosystem role of	1.7, 5.2	Years 1-3	Annual report on relevant new knowledge

		cephalopods, few studies consider species interactions other than predation. We also need to better understand the roles of fishing and climate change in determining biodiversity.			
d	Review, develop and recommend tools for cephalopod species identification at all life stages (adults, juveniles, paralarvae and eggs) and update best practice for routine data collection.	Cephalopod species identification in fishery and survey catches remains inconsistent and incomplete. Current standard data collection may be insufficient to support routine assessment. There is a need for easy-to-use regional identification guides (e.g. for fishers, fishery inspectors, buyers, and scientists undertaking sampling).	1.6, 3.2, 5.2	Years 1-3	Updated data collection recommendations (Annual);  Plan for ID guides (Y1);  New and revised ID guides (Y3)
e	Describe the value chain and evaluate the market drivers of cephalopod fisheries.	More information is needed on the social and economic sustainability of cephalopod fishing.	5.8, 7.2	Years 1-3	Case study reports on Iberian octopus (Y1), English Channel cuttlefish (Y2) and squid fisheries (Y3)
f	Review advances in knowledge on environmental tolerance of cephalopods, develop simple climate envelope models of cephalopod habitat as a potential forecasting aid.	Despite high phenotypic plasticity, cephalopod distribution is limited by extremes of temperature, salinity, dissolved oxygen, etc. and it is expected that climate change will lead to range shifts.	1.3, 1.5, 2.5	Years 1-3	Paper on climate envelopes and forecasting range shifts (Y3)

### Summary of the Work Plan

Year 1	Routine reporting on all ToRs. Plan for ID guides (ToR d). Reports on management options (ToR b) and socioeconomics of Iberian octopus fisheries (ToR e)
Year 2	Routine reporting on all ToRs. Report on socioeconomics of English Channel cuttlefish fisheries (ToR e).
Year 3	Routine reporting on all ToRs. Delivery of ID guides (ToR d) and report on socioeconomics of squid fisheries (ToR e). Paper on climate envelope models (ToR f)

### Supporting information

Priority	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.
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	<p>Furthermore, the planned preliminary assessments 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-d are envisaged as standing ToRs. ToR a is fundamental to support stock assessment (ToR b) 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 identification of cephalopod catches to species level.</p> <p>ToR e aims to ensure that social and economic sustainability of cephalopod fisheries are better understood, a key requirement for integrated ecosystem assessment. ToR f addresses effects of ocean warming on cephalopod distribution. Evidently, cephalopods show considerable plasticity, and climate change may also affect larval transport and predator-prey relationships, which will also affect distribution. Nevertheless modelling likely physiological limits to distribution should contribute to forecasting.</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 10-15 members and guests, 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	<p>Possible links with ICES groups working on predators of cephalopod (e.g. WGBIE, WGCS, WGMME).</p> <p>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.</p> <p>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.</p>
Linkages to other organizations	WGCEPH maintains links with ongoing European and national research projects and with the Cephalopod International Advisory Council.

### Joint ICES/ PICES Working Group on Small Pelagic Fish (WGSPF)

**2019/FT/EPDSG05** A Joint ICES/ PICES Working Group on Small Pelagic Fish (WGSPF), chaired by Myron Peck, Germany (ICES), Ignacio Catalan, Spain (ICES), Ryan Rykaczewski, USA (PICES), and Akinori Takasuka, Japan (PICES) will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2020	9-12 March	Copenhagen, Denmark		Inter-sessional meeting, funding mechanisms being explored. Location dependent on success of funding raising efforts.
Year 2020	22-30 October	Online meeting		(PICES AM)
Year 2021	10, 13-14 September	Online meeting		(ICES ASC)
Year 2021	18-29 October	Online meeting	Final report by January 2023	(PICES AM)
Year 2022	April - TBD	Online meeting		Synthesis writing workshop planned (depending on successful funding applications)
<i>Year 2022</i>	<i>September</i>	<i>TBA</i>		<i>(ICES ASC)</i>
<i>Year 2022</i>	<i>October</i>	<i>TBA</i>		<i>(PICES AM)</i>
Year 2022	Late November	Lisbon, Portugal		SPF Symposium

### ToR descriptors

TO R	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	DURATION	EXPECTED DELIVERABLES
a	To review recent progress on understanding how various drivers (environmental and/or anthropogenic) impact the population dynamics of SPF in different ecosystems and whether and how potential drivers shift with changes in ecosystem state.	a) Science Requirements	1.2, 1.3, 2.2	3 years	Review paper(s) within peer-reviewed journal
b	Create a networking environment for international and multidisciplinary collaboration to foster the establishment of similar study frameworks and comparative analyses of SPF across different social-ecological systems, based on updated time series data sets of climate indices, environmental factors and fisheries biology as well as ecophysiological information	a) Science Requirements	1.9, 5.2	3 years	Meeting reports submitted to ICES and PICES, Perspective Paper(s) submitted to peer-reviewed journal(s)

	(feeding, growth and survival).				
c	Identify, prioritize and conduct research most needed to advance our knowledge and capacity to predict the population dynamics of SPF at both short (seasonal to inter-annual) and long (decadal to centennial) time scales.	a) Science Requirements	1.3, 7.6	3 years	Meeting reports submitted to ICES and PICES, Perspective Paper(s) submitted to peer-reviewed journal(s)
d	Recommend strategies of marine ecosystem monitoring and fisheries management of SPF which will contribute to sustainable ecosystem-based fisheries management, through biophysical, ecosystem and/or socio-economical models.	a) Science Requirements	2.5, 3.1, 4.1	3 years	Meeting reports submitted to ICES and PICES, Perspective Paper(s) submitted to peer-reviewed journal(s)
e	Propose topic sessions at PICES Annual Meetings and ICES Annual Science Conferences focused on advances in SPF science and to organize a joint ICES/PICES symposium on SPF at regular intervals (e.g., once every 4 years) leading to the publication of findings in special issues of primary journals.	a) Science Requirements	NA	3 years	Joint ICES-PICES theme sessions.  An International ICES-PICES SPF symposium (follow-up to March 2017 Victoria meeting)  Special issue(s) in peer-reviewed journal(s)

### Summary of the Work Plan

Year 1	Initial meeting will take place in Spring 2020 of members from both ICES and PICES communities including a broader array of scientists from non-ICES and PICES regions (e.g. Humboldt EBUS, Mediterranean Sea). The ToRs will be discussed. Emphasis will be on summarizing ongoing work in various regions and scoping of joint research activities such as comparative analyses to be conducted by participants. A resolution for an international symposium on small pelagic fish will be submitted to ICES prior to the kick-off meeting. Two additional meetings will take place at the ICES ASC and PICES AM.
Year 2	An international Symposium will be convened (tentatively in late November / early December in Barcelona, Spain) immediately followed by a writing workshop to start producing synthesis articles stemming from activities in Year 1 and outcomes of the SPF symposium. The group will also meet at the ICES ASC and PICES AM.
Year 3	Meetings will take place at the ICES ASC and PICES AM. Final reporting of this first, 3-year phase of this group will be prepared. It is anticipated that a resolution will be submitted to extend the life-time of this joint group beyond this first, three-year phase.

### Supporting information

Priority	Small pelagic fish (SPF) account for more than 30% by weight of the total landings of marine capture fisheries around the world. They also play an important role in the transfer of energy through mid-trophic levels in marine ecosystems and are key resources for the world's growing aquaculture industry. The oscillations in the populations of SPF
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are dramatic and cyclical in response to climate variability on multi-decadal time scales. However, mechanisms linking climate variability to population dynamics are still unresolved. Hence, there are many challenges to sustainable use of SPF production. As the population dynamics of SPF display basin-scale teleconnections, synthetic and multidisciplinary studies are required to understand the processes and mechanisms to build predictive capacity.

International collaboration on SPF research was spearheaded by the GLOBEC Regional Program on Small Pelagic Fish and Climate Change (SPACC), launched in 1994 with a workshop in La Paz, Mexico. The SPACC program aimed to understand and predict climate-induced population dynamics of SPF in relation to physical and biological processes and included several major themes: long-term changes in ecosystems, retrospective analyses, comparative population dynamics, reproductive habitat dynamics, and economic implications of climate variability. The SPACC program culminated in 2010 with the publication of its review book. Since then, no international program specific to SPF has been launched, even though SPACC-II visions have been discussed (e.g., Alheit (2010) and van der Lingen et al. (2010)). In the following decade, there has been substantial scientific progress made in several ecosystems: different hypotheses of mechanisms of population dynamics of SPF have been proposed, data from long-term monitoring and stock-assessment efforts have accumulated, numerical modelling approaches have progressed, and technologies such as genome analysis have rapidly developed. ICES and PICES co-sponsored a symposium on “Forage fish interactions: Creating the tools for ecosystem-based management of marine resources” (Nantes, France, November 12–14, 2012) leading to publication of 12 articles in the ICES Journal of Marine Science (Peck et al., 2014). The need for a platform to organize intensive international collaboration was re-confirmed during the PICES/ICES Symposium on “Drivers of dynamics of small pelagic fish resources” (Victoria, BC, Canada, March 6–11, 2017). This symposium led to special issues in Deep-Sea Research Part II (Alheit et al., 2019; 15 articles) and Marine Ecology Progress Series (Alheit and Peck, 2019; 22 articles). The platform for international collaboration will allow the marine science community to more rapidly address challenging goals such as to:

1. Perform a synthesis of mechanisms linking climate variability to population dynamics of SPF among different ecosystems to reconcile various recruitment hypotheses;
2. Gain an holistic, ecosystem-level view of the causes and consequences of fluctuations in SPF populations such as how different factors (physical forcing, trophodynamics, and fishing pressure) interact to control the dynamics of populations;
3. Unite various fields (climate science, oceanography, plankton and fish ecology, quantitative fisheries stock assessment, sociology and economics) to build interdisciplinary approaches to examine SPF in social-ecological systems;
4. Incorporate new monitoring (e.g., environmental DNA) and modelling (e.g., end-to-end) technologies to better understand and manage pelagic ecosystems;
5. Provide projections of the effects of climate change on the distribution and productivity of SPF;
6. Propose strategies to safeguard marine ecosystem services stemming from SPF including conservation concerns related to SPF and their predators.

Because small pelagic fish (SPF) are highly valued by society and exhibit variability associated with changes in climate forcing, ecosystem structure, and fishing pressure, efforts to understand their dynamics require an integration of knowledge across oceanographic disciplines. Human society cannot expect to prepare a plan for sustainable development of the oceans unless we can improve our understanding of the largest component of ocean fisheries—the small pelagic fish. Consideration of the dynamics of these species, their sensitivity to exploitation and climate change, and the implications of such changes for the human populations that they support is essential to promote ocean sustainability and guide adaptation. The activities of the proposed joint

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working group will contribute primarily to the first three of the six goals identified in the PICES Strategic Plan (<https://meetings.pices.int/About/PICES-Strategic-Plan-Oct-2016.pdf>): (1) Foster collaboration among scientists within PICES and with other multinational organizations; (2) Understand the status and trends, vulnerability, and resilience of marine ecosystems; and (3) Understand and quantify how marine ecosystems respond to natural forcing and human activities (Goals 2 and 3 are similar to the two research themes in the PICES integrative scientific program on Forecasting and Understanding, Trends, Uncertainty and Responses of North Pacific Marine Ecosystems (FUTURE)). The activities of the joint working group also align with at least five of the seven ICES science priorities set in the ICES Strategic Plan ([https://issuu.com/icesdk/docs/ices\\_strategic\\_plan\\_2019\\_web](https://issuu.com/icesdk/docs/ices_strategic_plan_2019_web)), including: (1) Ecosystem science, (2) Impacts of human activities, (3) Observation and exploration, (4) Seafood production and (5) Conservation and management science.

The activities of this joint WG are considered to have a very high priority for both ICES and PICES.

#### References:

- Alheit, J. (2010) SPACC continues under ICES wings. GLOBEC International Newsletter, 16(1): 24.
- van der Lingen, C.D., Lluch-Cota, S., Checkley, D., Bernal, M., Herzka, S., and Takasuka, A. (2010) SPACC II Planning Meeting 24-26 February 2010, La Paz, Mexico. GLOBEC International Newsletter, 16(1): 25–26.
- Alheit, J., Rykaczewski, R.R., Sundby, S., and Di Lorenzo, E. (2019) Drivers of dynamics of small pelagic fish resources: environmental control of long-term changes. Deep Sea Research II (special issue), 159: 1–3
- Alheit, J. and Peck M.A. (2019) Drivers of dynamics of small pelagic fish resources: biology, management and human factors. Marine Ecology Progress Series (special issue), 617/618: 1–6.
- Peck, M.A., Neuenfeldt, S., Essington, T.E., Trenkel, V.M., Takasuka, A., Gislason, H., Dickey-Collas, M., Andersen, K.H., Ravn-Jonsen, L., Vestergaard, N., Kvamsdal, S.F., Gårdmark, A., Link, J., and Rice, J.C. (2014) Forage Fish Interactions: A symposium on “Creating the tools for ecosystem-based management of marine resources”. ICES Journal of Marine Science (special issue), 71: 1–4.

Resource requirements	Some resources to support travel of key group members to PICES Annual Science Conferences will be requested (see below).
Participants	The group is expected to attract between 25 to 35 members and guests with broad coverage of ecosystems within and outside ICES and PICES regions.
Secretariat facilities	The group will request meeting rooms / times associated with the ICES ASC. This will require some assistance from members of the secretariat organizing those events. Similar requests will be made of the PICES secretariat.
Financial	Funds will be requested to support travel of key participants to the PICES ASC.
Linkages to ACOM and groups under ACOM	The group will identify how environmental drivers influence the productivity of SPF within ICES areas. This information will be useful to ACOM.
Linkages to other committees or groups	It is anticipated that very close working relationships will be created with other groups within the Ecosystems, Processes and Dynamics Steering Group such as those working on predators (e.g. JWGBIRD) and prey (WGZE) of SPF. Similarly, the work conducted will be useful to food web modelling (e.g. WKEWIEA) and to state-of-the-art biophysical modelling (e.g. WGIPEM) within SG Integrated Ecosystem Assessments.
Linkages to other organizations	Joint partnership between ICES and PICES: the proposal is simultaneously submitted to PICES;



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FAO General Fisheries Commission for the Mediterranean (GFCM);

<http://www.fao.org/gfcm>): Working Group on Stock Assessment of Small Pelagic Species;

North Pacific Fisheries Commission (NPFC; <https://www.npfc.int/>): Technical Working Group on Pacific Saury Stock Assessment (TWG PSSA) and Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA);

UN Decade of the Oceans: The mandate of this joint ICES/PICES activity is relevant to the objectives of the UN Decade of Ocean Science for Sustainable Development and UN Strategic Development Goals (*e.g.*, SDG 14, Life Below Water).

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

**2019/FT/EPDSG06** A Joint ICES-PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields (WGGRAFY), chaired by C. Tara Marshall, UK (ICES), Paul Spencer, USA (PICES), Alan Baudron, UK (ICES), Shin-ichi Ito, Japan (PICES), and John Morrongiello, Australia (Guest) will work on ToRs and generate deliverables as listed in the Table below.

The ToRs describe a programme of co-ordinated research to be undertaken by a global network of scientists. The ToRs have been developed jointly through discussions at an earlier workshop (Aberdeen 2018). Given the specific nature of the ToRs it is the intention of the co-chairs to minimise the need for face-to-face meetings. Instead work on the ToRs is progressed via remote working and communicated via technological means, including email and skype. WG meetings will be timed to coincide with other international meetings that the co-chairs are attending. Meetings will use video conferencing to allow other WG members to participate remotely. This has several practical advantages. It minimises the requirement for WG participants to secure the substantial funding required for international travel. Secondly, it minimises cumulative carbon emissions of the WG thereby constituting a more climate-friendly programme of research. This working practice will be challenge but is logical given that the WG concerns climate impacts.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2019	September	ICES ASC, Sweden		Information meeting with co-chairs and prospective members attending the ASC. Develop strategy for securing participants meeting WG needs.
Year 2020 (Year 1)	7-10 September	Online meeting		(ICES ASC- progress reporting on ToR activities; chairs attend, optional attendance by member)
Year 2021 (Year 2)	6 October	Online meeting		(PICES ASC- progress reporting on ToR activities; chairs attend, optional attendance by member)
Year 2022 (Year 3)	September	TBA		(ICES ASC- progress reporting on ToR activities; chairs attend, optional attendance by member)
Year 2022	November	Seattle, Washington (proposed)		Final meeting to complete publications (ToRs a,b,c) and strategy document (ToRd)

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Final report by January 2023

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## ToR descriptors

TO R	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	DURATION	EXPECTED DELIVERABLES
a	Assess the capacity of statistical models to incorporate temperature-dependency of growth, and then compare their predictions of growth variation across specific warming scenarios and locations		1.3, 1.7, 2.5	Year 1	Paper suitable for peer-reviewed fish journal
b	Analyse long-term growth patterns across multiple large marine ecosystems that are experiencing different trends in temperature, using a common modelling approach		1.7, 5.2, 6.1	Years 1, 2 and 3	Papers suitable for peer-reviewed, high impact generic journal
c	Assess the impacts of warming on past yield per recruit of commercial fisheries, and forecast trends in future yield given plausible warming scenarios		1.3, 5.2, 6.1	Year 3	Paper suitable for peer-reviewed, high impact generic journal
d	Identify options for expanding scientific community access to global length-at-age data that are routinely collected by fisheries agencies worldwide.		3.2	Years 1,2,3	Strategic plan assessing options for widening access to length-at-age data collected routinely (similar to how data can be accessed via Datras)

## Summary of the Work Plan

Year 0	Initial information meeting will take place in September 2019 at the ICES ASC which will be attended by all four co-chairs and interested individuals. The meeting will present and discuss the longterm goals of the WG, the individual ToRs and the specific requirements for prospective WG members. Following on from this meeting targeted email will be sent to individual scientists who are felt to have access to relevant data and/or valuable modelling skills. Members of the WG will come from both ICES and PICES communities but also a broader array of global scientists from regional seas experiencing warming, cooling or upwelling who hold longterm length-at-age data (e.g., Chile).
Year 1	A meeting may take place at the ICES Annual Science Conference to review progress towards ToRa and ToRd. Sub-groups meet remotely as required; full WG remotely meets once per year for progress reporting
Year 2	A meeting may take place at the PICES Annual Science Conference to discuss progress towards ToRs a, b and d. Planning for an international theme session will be convened (tentatively in Year 3 at ICES ASC). Sub-groups meet remotely as required; full WG remotely meets once per year for progress reporting

Year 3	A week-long meeting of the full WG will be held to complete writing of papers and will possibly be held at the University of Washington (UW). This location will facilitate discussion of data archiving using the arrangements for maintenance of RAM Legacy database UW as an example.
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## Supporting information

Priority	<p>The Temperature Size Rule (TSR) proposes that fish at warmer temperatures have rapid early growth and lower adult size (Forster et al. 2012). Several North Sea fish stocks have exhibited a synchronous, common trend towards smaller maximum body sizes that was correlated with increasing temperature. This “shrinking” decreased per-capita yields of those stocks by ca. 23% (Baudron et al. 2014). Similarly, it has been projected that by 2050 global fish yields will decrease by 14-24% due to shifting biogeography and the TSR (Cheung et al 2012).</p> <p>The aim of WGGRAFY is to determine whether temporal trends in individual growth rates of marine fish are consistent with the TSR and, if so, evaluate the impacts for fish yields. Length and age have been routinely measured for many commercial fish stocks on time scales that are associated with warming. These substantial data have never been compiled as a single, analytical resource for climate change research on global scales. The WG will compile length at age datasets for large marine ecosystems experiencing differential rates of warming or cooling or no overall trend (e.g., upwelling regions). A customised statistical approach for modelling growth will be developed to specifically test whether there is a component of the total variation in growth rates that can be attributed to temperature. This knowledge could provide a empirical foundation for forecasting the impacts of future climate warming on yields.</p> <p>The unique spatial and temporal scale of length-at-age data are valuable resource for ecological research. The WG will also develop a strategic plan for archiving length-at-age data similar to how ICES archives data for European waters (Datras) or how global data on recruitment and catch are reported and maintained (e.g., RAM Legacy). This will require engaging with various agencies (ICES, EMODnet, FAO, universities, tech specialists) and national fisheries laboratories as well as potential funding sources.</p> <p>References</p> <p>Baudron, A.R., Needle, C.L., Rijnsdorp, A., Marshall, C.T. 2014. Warming temperatures and smaller body sizes: synchronous changes in growth of North Sea fishes. <i>Global Change Biology</i> 20: 1023-1031.</p> <p>Cheung, W. W. L., et al. 2012. Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems. <i>Nature Climate Change</i>, 3:254–258.</p> <p>Forster, J., Hirst, A.G., Atkinson, D. 2012. Warming-induced reductions in body size are greater in aquatic than terrestrial species. <i>PNAS</i> 109:19310 LP-19314.</p>
Resource requirements	None anticipated due to nature of remote working.
Participants	The WG is expected to attract between 25 to 35 members including guests giving broad coverage of large marine ecosystems within and outside ICES and PICES regions.
Secretariat facilities	The group will request meeting rooms / times associated with the ASC. This will require some assistance from members of the secretariats organizing those events. It is envisioned that video conferencing facilities will be required such that non-attending WG members can participate.
Financial	Funds may be requested to support travel of key participants to the final and only meeting.
Linkages to ACOM and groups under ACOM	The group will identify how climate has influenced the productivity and yields of commercial fish stocks within ICES areas retrospectively. In addition, it will develop knowledge relevant to forecasting future impacts on fish growth rates. This information is compatible with the evolving knowledge base relating to climate-driven distributional shifts. This information will be useful to ACOM in recommending adaptation options for fisheries management.

Linkages to other committees or groups	Unknown but ICES WG related to otolith and aging, fish population dynamics and climate change would be relatively straightforward linkages.
Linkages to other organizations	Joint partnership between ICES and PICES: the proposal is simultaneously submitted to PICES; UN Decade of the Oceans: The mandate of this joint ICES/PICES activity is relevant to the objectives of the UN Decade of Ocean Science for Sustainable Development and UN Strategic Development Goals ( <i>e.g.</i> , SDG 14, Life Below Water).

### Working Group on the Biology and Life History of Crabs (WGCRAB)

The **Working Group on the Biology and Life History of Crabs (WGCRAB)**, chaired by Carlos Mesquita, Scotland, 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 2020	10–12 November	online meeting/ by corresp.		
Year 2021	9–11 November	online meeting		
Year 2022			Final report by DATE to SCICOM	

### ToR descriptors

ToR	Description	Background	<a href="#">SCIENCE PLAN CODES</a>	Duration	Expected Deliverables
a	Compile data on landings, discards, effort and catch per unit effort (CPUE) to provide standardised CPUE, size frequency and research survey data for the important crab and lobster ( <i>Homarus</i> ) fisheries in the ICES area, Atlantic Canada and Greenland. Maps will be produced to synthesise the data. Part of this data will be submitted to the ICES Data Centre.	Crab and lobster fisheries are economically important for many coastal populations in Europe and Canada and more specifically where the demise of fin fish occurred.	5.4; 4.1; 3.2	3 years	Landings, discards, effort and catch data on listed species from each country. WG report.
b	The EG will collate stock-assessment data for areas where the information is available. The working group will review methodologies to develop suitable standardized reference points for the management of the different stocks. Ex-	The data available for each fishery vary greatly. In some, the main management rules are quotas, licences and limitation of fishing gears to control the effort. The status of many stocks remains uncertain. Thus,	5.1; 5.3	3 years	Report on evaluation of assessment methods.

	plore and apply common assessment methods for crab and lobster stocks using available data including length distributions and abundance indices.	developing robust evaluation methods for many fisheries is necessary.			
c	Review the impact of environmental drivers (temperature, ocean acidification, climate change), diseases and pollution on important crab and lobster stocks within the ICES, Atlantic Canada and West Greenland; studying the effects on reproduction, recruitment, growth and distribution.	Crabs and lobsters, as many other species are impacted by environmental parameters. In the actual situation of climate change, WGCRA B must investigate the main importance on the recruitment and biomass trends.	5.2; 2.1	3 years	Highlight important issues to be basis for research on effect of climate changes on important crab stocks. WG report chapter.
d	Review research and generate new knowledge on vital crab and lobster population biology parameters and food safety.	Biological parameters are important for stock assessments and improved data will lead to more reliable outputs.	1.7; 1.8	3 years	Updated any new knowledge on crucial stock parameters for any crab and lobster stocks. Any updates or new knowledge will be outputted into summary tables.

### Summary of the Work Plan

Year 1	Annual standard outputs for a) and b). Continue analysis for c) and d).
Year 2	Annual standard outputs for a) and b). Continue analysis for c) and d).
Year 3	Annual standard outputs for a) and b). Complete report on analysis, research and report including all work for ToRs c) and d).

### Supporting information

Priority	High. In Canada as in Europe, fishermen activities are highly dependent of crab and lobster stocks. Moreover, available data vary depending on the country, which is why work on the assessment methods need to be continued, particularly on those countries where fishing data exist allowing the development of new approaches. The aim is to ensure statistically sound assessments of the main crab and lobster stocks in order to provide suitable conditions to develop good management practices and stability of all dependent fleets. The activity of the Group is therefore considered to be of high priority in particular if its activity can move towards resource assessment without losing biological inputs.
Resource requirements	The research programmes which provide the main input to this group are underway, and resources are already committed. The additional resources required to undertake activities in the framework of this group is not expected to be significant.
Participants	The Group is normally attended by some 10–15 members and guests.
Secretariat facilities	Standard support to WG
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	Potential linkages to some EGs under ACOM

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Linkages to other committees  
or groups

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Linkages to other  
organizations

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**EGs dissolved in 2021**

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WGS2D	Working Group on Seasonal-to-Decadal Prediction of Marine Ecosystems
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