

BENTHOS ECOLOGY WORKING GROUP (BEWG)

VOLUME 2 | ISSUE 115

ICES SCIENTIFIC REPORTS

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ISSN number: 2618-1371 | © 2020 International Council for the Exploration of the Sea

ICES Scientific Reports

Volume 2 | Issue 115

BENTHOS ECOLOGY WORKING GROUP (BEWG)

Recommended format for purpose of citation:

ICES. 2020. Benthos Ecology Working Group (BEWG).
ICES Scientific Reports. 2:115. 21 pp. <http://doi.org/10.17895/ices.pub.7625>

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Contents

i	Executive summary	ii
ii	Expert group information	iii
1	Long-term benthic series and climate change	1
2	Species distribution modelling and mapping	3
3	Benthos and legislative drivers.....	4
4	Benthic biodiversity and ecosystem functioning.....	7
5	Benthic biodiversity and conservation: to review the role of benthic ecology in MPAs.....	10
6	Explore the feasibility to undertake studies (e.g. laboratory or field experiments) to test ecologically relevant hypothesis in relation to benthic responses.....	11
7	Cooperation.....	12
Annex 1:	List of participants.....	13
Annex 2:	BEWG Resolutions	18

i Executive summary

The Benthos Ecology Working Group (BEWG) aims to study, describe and update on all aspects relevant to the ecology, functioning and interactions of marine benthic species (living in or within the sediment), either macro, meio and epifauna across the North Eastern Atlantic.

This report contains the overview of ongoing initiatives covering central aspects of benthic ecology. The work is focussed on: benthic long-term series and climate change, benthic indicators, species distribution modelling, the link between biodiversity and ecosystem functioning and the role of benthos within MPAs. The work conducted over the past three years has concentrated on assessing the current challenges in methodological approaches associated to the study of climate change and long-term benthic assessments. The BEWG is in the process of drafting a communication paper, to showcase the benefits, challenges, and examples of benthic time-series usage. The work centres on the dedicated monitoring and assessments of benthic systems. Some of these assessments are challenged and compromised due to the lack of relevant samples, funding, and methodological changes over time (e.g. new equipment and/or new sampling design).

The BEWG members are also participants of the EU EmodNET biology consortium, therefore keeping up to date with current and relevant data series initiatives. A case study is under development, assessing the level of variability in expert assessment of benthic species tolerances /sensitivities. This case study has been developed in consultations with over relevant ecological questions, dedicated assessments across ecologists, their training and their influences of their network in their assessments. The work on benthic indicators and effective monitoring programmes (including design, harmonisation, and quality assessments) is progressing well and dedicated examples from all members were shared and discussed. The work on the relevant benthic indicators for ecosystem quality assessment, based on a functional indicator needs in support of the MSFD is still in draft and a sub-group will continue with intersessional work to report in 2021. A series of benthic, biological traits and sediment data sets has been compiled, the work aims to test what are the “changes in functional composition along sediment gradients”, which has been discussed and will be advanced and reported in 2021. The benthic ecology and conservation work developed on the paper published this summer under the topic of “the role of benthos within MPAs” has been well received and actively disseminated.

ii Expert group information

Expert group name	Benthos Ecology Working Group (BEWG)
Expert group cycle	Multiannual
Year cycle started	2018
Reporting year in cycle	3/3
Chair	Silvana Birchenough, UK
Meeting venue(s) and dates	14–18 May 2018, Banyuls-sur-mer, France, 24 experts
	6–10 May 2019, Coleraine, Northern Ireland, 17 experts
	11–15 May 2020, online meeting, 23 experts

1 Long-term benthic series and climate change

Overview of the BenthOBS initiative

Introductory presentation by Nicolas Desroy and Vincent Bouchet

Nicolas Desroy provided an overview of this initiative. The French benthologists are working on the constitution of an observatory of benthic macrofauna. This survey will be called BenthOBS (as Observatory of Benthic Macrofauna). BenthOBS will consist of a network of sampling stations along the coasts of France from the Belgium border down to the Italian one. All stations will be sampled bi-annually, and the same protocol will be followed by all laboratories. Data from the survey will be available for free. Once funded by our institutes, BenthOBS will run for a minimum period of 5 years. Theoretically, French National Service of Observation lasts almost for ever. Hence, BenthOBS intends to provide a service to the community. For instance, data on the diversity of benthic macrofauna produced by BenthOBS could be of interest for members of the ICES Benthic Ecology Working Group for mutualization of long-term series data to answer questions, such as: What is the evolution of benthic macrofauna communities in the context of global warming?

This work will be annually updated to keep everyone in the loop and to foster further participation. The BEWG members were interested and supportive of this initiative, as the outcomes will have direct connection with ToR A related work.

The ongoing work under ToR A, was discussed and agreed that there is an important message to convey with regards to benthic time-series. The group has supported the idea to scope an opinion document. The group effectively discussed and populated a document, some of the work will be done intersessionally (mainly over the summer and autumn months in 2020) to effectively gather the literature and details. A tentative title has been agreed:

- Birchenough, S.N.R., Reiss, H., Craeymeersch, J., Montagna, P., Dannheim, J., Vanaverbeke, J., Labrune, C., Blomquist, M., Guerin, L., Oug, E., Donnay, A., Degraer, S., Hunter, B. and Jan Beermann, J. (*in prep.*) The value of benthic long-term time series: bringing the science to support management decisions. Journal TBD. Letter style contribution.

Abstract: The focus of the present paper has been drafted to document the importance of marine benthic long-term series. These long-term data sets are important elements of marine monitoring, there is a clear need that they should be integrated with other monitoring activities to support the requirements of marine management. Our approach is to: 1) illustrate why long-term series are essential to our understanding of benthic ecosystems, 2) demonstrate what knowledge from long-term studies is fundamental for management questions of ecosystem state and effect monitoring of responses to actions, 3) discuss how long-term series should be designed to provide maximum benefit for management objectives, and 4) assess how to inform managers of the benefits of long-term series and the need of basic ecosystem knowledge to address emerging and new management issues. The work is supported by some of the existing metadata data of the long-term time series, collated during the Belt-net initiative over many years of available benthic monitoring.

Belts-NET/EMODNET

The current EMODNET biology initiative has been discussing a series of products and ways to effectively display data sets (e.g. abundance, presence/absence, traits-based data, etc.). A brief overview was presented by Silvana Birchenough on the ongoing activities of this work. Several Emodnet Biology members have published some examples based on several types of data products that can be considered to support management, conservation and advice on marine resources. The work was recently published in Marine Policy, the link with the publication is below:

<https://www.sciencedirect.com/science/article/pii/S0308597X19301915>

Reference:

Lear, D., Herman, P., Van Hoey, G., Schepers, L., Tonné, N., Lipizer, M., Birchenough, S.N.R (2020). Supporting the essential-Recommendations for the development of accessible and interoperable marine biological data products. Marine Policy 117, 103958. <https://doi.org/10.1016/j.marpol.2020.103958>

2 Species distribution modelling and mapping

Report on ongoing case study: “Towards a benthic ecosystem functioning map: interregional comparison of two approaches”

Silvana Birchenough updated the state of play for this ToR in M. Gogina’s absence. The work is now developed and published. See below recent paper and full reference:

Gogina, M., Zettler, M.L., Vanaverbeke, J., Dannheim, J., Van Hoey, G., Desroy, N., Wrede, A., Reiss, H., Degraer, S., Van Lancker, V., Foveau, A., Braeckman, U., Fiorentino, D., Holstein, J., Birchenough, S. N.R. (2020) Interregional comparison of benthic ecosystem functioning: community bioturbation potential in four regions along the NE Atlantic shelf”. *Ecological Indicators* <https://doi.org/10.1016/j.ecolind.2019.105945>

The BEWG agreed that this work will continue going forward, several ideas were discussed as the BEWG members are still very supportive of development of new methods, ideas, and consideration of further functional aspects. At the time of discussion Alexa Wrede also mentioned ongoing methodological activities in Germany, she also referred to functional initiatives in support of follow up work in this area. The BEWG also discussed issues associated with habitat types, species of conservation importance and the need to incorporate spatial scales/regions. A dedicated discussion with the need and view to scope new ideas will be done at the next 2021 BEWG meeting. Alexa Wrede and Mayya Gogina will continue with further discussion at the next 2021 meeting.

3 Benthos and legislative drivers

Report on the use of benthic indicators and ongoing initiatives

Benthic indicators are a very important area of work across several members of the BEWG. A series of national updates with regards to benthic indicator developments and MSFD (e.g. from Germany, Sweden, France and Belgium) will continue to be updated during the BEWG meetings, as these will further develop, depending on MSFD requirements.

Following from these national introductions, the group intensively discussed the different approaches to assess benthic habitats with respect to D6 MSFD and the potential role of ICES BEWG as an additional expert group besides OSPAR BHEG, HELCOM EN BENTHIC and EU TG SeaBed. One issue was associated with the question on how to interpret the EU MSFD D6 criteria from an ecological viewpoint to enable this aspect to then be linked with ongoing monitoring strategies. It was agreed to open a sub-ToR on this task which want to tackle the research question “What does adversely affected mean with respect to the given parameter, biodiversity, structure, and functioning?” The concept will be tested based on case studies and will lead to a data driven paper. This should further underpin the scientific development of the concept of ‘adversely affected’ in relation to the MSFD assessment framework.

Aspects related to this research questions: What does adversely affected mean with respect to the given parameter, biodiversity, structure, and functioning?

- Spatial extend- what is the percentage of an ‘*adversely affected*’?
- What is the real health status?
- Risk versus impact versus status assessments: how to compare and use them in relation to EU directive assessments.
- There is a need to consider dedicated development of advice on monitoring strategy/design

Therefore, the BEWG is looking for appropriate case study areas, which made following criteria:

- Detailed spatial coverage of data in a sub-area
- Several pressures going on (local versus large scale pressures)
- One or a few habitat types
- Availability of overall stations (not direct subjected to pressure), or long-term monitoring stations (to know what is happening in the area) more for general status assessment
- Data sets for: infauna + (epifauna) (or the entire sea-bottom ecosystem)
- Data originating from one source or several sources (grab, video, ...)
- An idea on the overall status of that sub-area. → several issues associated with a reference issue
- Several indicator approaches could be tested
- Structural and (functional) indicator approaches, could be also complemented with other ongoing initiatives
- A case study lead should be able to perform the analyses on the case study dataset, based on a common protocol.

Data already collected from other initiatives can be starting point. The group will continue these discussions in 2021 to delineate appropriate case studies and develop a common analyse methodology and case study leads.

Presentation: European Invertebrate Atlas initiative

N. Desroy

Completed and published. N. Desroy will distribute a copy to all BEWG members. The volumes are available online:

<https://archimer.ifremer.fr/doc/00612/72370/>

Update on OSPAR benthic habitat works, on BAltantic project, and possible synergies with BEWG

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Abstract

Following the online publication of OSPAR intermediate assessment mid-2017, the next main driver for OBHEG works is now the contribution to the next OSPAR Quality Status Report, planned to be published in 2023. The 2019 workshops report and next milestones are presented to facilitate and identify synergies with this ICES Benthic Ecology Working Group current or planned works. Besides, the aim, methods, and very preliminary results of the BAltantic project are presented to suggest possible synergies with other benthic works conducted or planned in this group. Dedicated ideas will be discussed to support and promote further integration between the work under the BEWG and this programme.

An update on the activities conducted by the Working Group on Fisheries Benthic Impact and Trade-offs (WGFBIT), co-chaired by Gert Van Hoey was summarised at the meeting. This work will be closely aligned with the scientific work developed under the BEWG. Gert Van Hoey provided an update on the work and ongoing initiatives. For more details on the group ToRs, activities and contacts with other EG, visit their website: <https://www.ices.dk/community/groups/Pages/WGFBIT.aspx>

Investigate the importance of species autecology in indicator development and application

S. Degraer and H. Hillewaert presented the current state of the ongoing initiative investigating the variability in expert judgement of sensitivity of indicator species. The invitation letter and the questionnaire were finalized intersessionally. They will be contacting the experts after the meeting. The initiative will progress intersessionally and further updates will be done in 2021.

Review the development of effective monitoring programmes, e.g. design, harmonisation and quality assessments (e.g. MPAs). Case study developed under the Joint Monitoring Programme - JMP

G. Van Hoey led this initiative in collaboration with several BEWG members that participated during the EU funded Joint Monitoring Programme of the North Sea and Celtic Sea and lead to the publication:

Van Hoey, G., Wischniewski, J., Craeymeersch, J., Dannheim, J., Enserink, L., Guerin, L., Marco-Rius, F., O'Connor, J., Reiss, H., Sell, A.F., Vanden Berghe, M., Zettler, M.L., Degraer, S., Birchenough, S.N.R., 2019. Methodological elements for optimising the spatial monitoring design to support regional benthic ecosystem assessments. *Environmental monitoring and assessment* 191:423 DOI: 10.1007/s10661-019-7550-9

G. Van Hoey announced a workshop entitled: **“Roadmap for integrated benthic monitoring in Greater North Sea: scoping workshop**, initiated by OSPAR BHEG and the Netherlands, with the aim to develop a roadmap for integrated benthic monitoring. This will be in co-operation and communication with the ICES BEWG community. The goal of this process is to develop an integrated benthic monitoring program for the Greater North Sea region serving the assessment of the national and common benthic indicators within the OSPAR region.

A very detailed online survey was executed in 2018-2019 about monitoring practices (from sampling to data storage and sampling designs) in the Greater North Sea area (Van Hoey & Wittoeck 2019). This survey has listed the similarities and dissimilarities in monitoring practices between 15 institutes. The aim of this meeting is to discuss this document, to agree on aspects that can be harmonized and to set-up a road map to achieve some harmonization in the sampling, laboratory practices and sampling design.

4 Benthic biodiversity and ecosystem functioning

Report on the ongoing case study to assess ecological responses across sediment gradients

J. Dannheim presented the overall progress on this initiative. The two scientific questions of this initiative are (a) whether there are any differences in trait composition between different substrates and (b) if these are consistent between different regions. So far, this initiative has captured a total of ten case studies covering the Baltic Sea, the Mediterranean Sea, the Norwegian Sea and the North Sea. A very good progress has been made on the data cleaning for the biological and sediment data. The initiative is now moved to the next phases to deal with traits data sets. During the meeting, a detailed discussion on the selection and definitions of biological traits, traits modalities and coding was carried out and a final set of biological traits was decided on. A collation of biological traits data bases will be compiled by Mats Blomqvist. The traits work will continue by BEWG experts intersessionally and an update will be given next year at the BEWG meeting.

J. Dannheim discussed a series of sub-group questions to ensure the traits scoring, use of data bases and overall details were well agreed and co-ordinated across BEWG members participating on this initiative.

- Some of the aspects still need to be checked are: i) the variability between years, ii) the beta diversity linked to particular sediments, iii) possible methodological issues (sieves, biomass measurement), iv) different sample sizes per sediment types (Gert Van Hoey volunteered to check this aspect). There are several tasks for the biological traits work, these are: i) the most dominant species were identified, with a total of 11 traits with 47 modalities. The available trait data was screened and organized accordingly;
- Several aspects to consider are the coding of all modalities for each species across data sets. Jenny suggested to form small coding teams based on the respective geographic region of expertise. A first cross-check exercise of subgroup coding teams aims to identify potential problems and respective solutions such as how to deal with mismatches in the modalities; coding guidelines and template were discussed and provided. This work also identified the need for a fully referenced trait database (primarily based on publications only, to ensure that the information is consistent and published, if possible); most databases are already included, further trait databases can probably be integrated in the process of the coding;
- There is also the need to consider the trait list, as it should be double-checked for possible interlinks that could distort the analysis (the total number of traits may be reduced depending on the research question);
- The group decided to run an exercise and make a first coding attempt into subgroups with 3 most common species that occur in all marine regions in the afternoon. The work was used as an example to ensure consistency, data and agree a future step on how to continue this work.

Coding guidelines and benchmarking

Why two tables?- the cross-table and the row-table

In the cross-table, we would have to add a column “reference” for each modality to keep the information, but this is not practical. We have to store the information in the row-table, which is the MAIN biological trait DB. Further, the row-table is database conform. It is inevitable to collect the information on the sources and references, as this is highly important for quality assurance, transparency and repetition of the scientific knowledge. Without references (source and/or reference) it will be impossible to publish it, I would say, as this would be no good scientific

With the row-table format, we might end up with e.g. 10 rows on one taxon-trait-modality combination because of different references, sources and fuzzy coding.

Some of the options could be that the experts fill out only an “x” in the cross-table for all the information they collected, i.e. “cross-out” the taxon-modality-trait information collected in the row-table. Another option could be that the experts must assign the final scores (and fuzzy codes) to the taxon-modality-trait in the cross-table, but this decision has to be saved/justified somewhere.

Source and reference definition:

Source in the document is defined as databases (e.g. Arctic traits, Polytraits). In some source, these are referenced for the species-modality-taxon information, hence we have two columns in our table, source (e.g. ArcticTraits) and reference (e.g. Kott, P. 1985 The Australian Ascidiacea. *Memoirs of the Queensland Museum*, 23:1-440) and for some only a reference (e.g. Wrede *et al.* 2018). However, references are preferred (with DOI) to have the original reference of the information and not a blurred because several times re-cited reference such as e.g. Marlin data base.

General comment on fuzzy coding

Fuzzy coding sensitive to differences:

- in years/seasons
- between regions
- knowledge differences

(For several sources, fuzzy code is given for a taxon-modality-trait from other sources. We kept the fuzzy code as a suggestion for coding teams and final coding to be decided.)

Difficulties with trait-modality information collection

Categorical information

Some of the traits are listed as categorical in some sources. How shall we deal with knowledge differences for these? Especially feeding type can vary.

Suggestion: fuzzy code these categorical traits as fuzzy code = 3

Differing/contrasting information

There may be several sources (and references) for one taxon-modality-trait. How shall we treat that?

Suggestion: We can have several rows for one species in the row-table. Each row stores for each taxon-modality-trait the information from several sources/references.

Differing modalities from BEWG modalities

In some cases there is a one-to-one relationship between other database info and what we want in our BEWG database (e.g. ArcticTraits S2-S5), but in other cases there is information in other databases that cover several modalities in what we want or vice versa (e.g. some size classes). Where we have a one-to-one relationship, we can transfer the information directly (as Mats did), but in the other cases Mats only produced helpful information as a background but no suggestion for a result in the coding.

Mismatching of modalities from BEWG modalities

Two examples

Polytraits	modality	fuzzy code
Size	>100	3



BEWG	modality	fuzzy code
Size	100-300	2
Arctictraits	modality	fuzzy code
longevity	5-20	1
	>20	2



BEWG	modality	fuzzy code
longevity	5-10	1
	>10	1 & 2

For example, e.g. size class >100 mm from Polytraits is useful but further information is needed to assign one of our classes 100-300 or > 300.

Suggestion: In this case, the classes can be just re-coded: This would be fuzzy code = 2 for class 100-300 and fuzzy code = 2 for class >300.

One detail with this suggestion, i.e. expanding the source modalities that matches two modalities in our list to two records with fuzzy code 2. There might be situations where a taxa is assigned to two source modalities out of which one matches two in our BEWG list. For example, *Ophiura sarsi* is assigned to longevity A3 5-20 and A4 >20 in Arctictraits with fuzzy code to 1 and 2. BEWG longevity modalities are 5-10 and >10. Arctictraits A3 would then be both 5-10 and >10 with fuzzy code 2 and A4 >10 with fuzzy code 2. Therefore, we would end up with three records and two of them very similar but with different references. The original fuzzy code 1 on A3 will be lost. There are a lot of details that will need to be considered going forward with this exercise.

Consider new functional indicator needs to support MSFD requirements.

The BEWG decided that a first steps for this initiative is to include functional relevant indicators. The discussion also supported the compilation of links between benthic functions and ecosystem services.

There are several ideas on how to progress and integrate with other ongoing indicatives (e.g. WGMRED). A discussion was held during the meeting on existing conceptual frameworks. The work will be developed over a draft document scoped at the meeting, bringing the new knowledge and current gaps associated with functional indicators under MSFD. Billy Hunter will be leading on this work with a dedicated sub-set of BEWG experts; further intersessional discussion will be conducted after this meeting. The intention is to report on progress at the next BEWG meeting in May 2021.

5 Benthic biodiversity and conservation: to review the role of benthic ecology in MPAs

Review and report on the implications of the designation and management of Marine Protected Areas in relation to role of benthic ecology

The work was discussed and the BEWG will continue to work under this ToR. The data compilation for the MPA paper provided a good sense of evidence, but further questions could be explored from this work. The group agreed to continue with this work over the next 3 years.

Marine Protected Areas (MPAs) hold species and habitats protected under law. There is concern across the ICES region that consideration of vulnerable components and wider support mechanisms underpinning benthic marine ecosystems may not be as accurate under the process of MPA designation, management and monitoring. In this study, MPAs across six European ecoregions were assessed from a benthic ecology perspective, to highlight issues regarding the representation and protection of benthic ecosystems in MPAs. The assessment comprised 102 MPAs, designated by ten countries, and focused on three aspects regarding the role of the benthos in: (i) the designation of the MPA (ii) management measures, and (iii) monitoring and assessment. A pedigree matrix was applied with a numerical scale to a set of qualitative entries collected by 19 benthic experts (active members of the ICES Benthic Ecology Working Group (BEWG)) in a dedicated questionnaire.

The results showed clear differences in scores between ecoregions and between criteria. The designation phase criteria generally achieved higher scores than the implementation phase criteria and the regional differences in scores were not consistent between the designation and implementation phases. The work is summarised in:

Greathead, C., Magni, P., Vanaverbeke, J., Buhl-Mortensen, L., Janas, U., Blomqvist, M., Craeymeersch, J., Dannheim, J., Darr, A., Degraer, S., Desroy, N., Donnay, A., Griffiths, Y., Guala, I., Guerin, L., Hinchén, H., Labruno, C., Reiss, H., Van Hoey, G., Birchenough, S.N.R. (2020) Exploring the use of a generic framework to illustrate the importance of benthic marine ecosystems to the effectiveness of MPAs. *Aquatic Conservation* <https://doi.org/10.1002/aqc.3401>

The BEWG wishes to dedicate this MPA conservation work to their friend and colleague Dr Clare Gateshead, who sadly died on the 24th July 2020:

https://www.ices.dk/news-and-events/news-archive/news/Pages/Clare_Greathead.aspx

6 Explore the feasibility to undertake studies (e.g. laboratory or field experiments) to test ecologically relevant hypothesis in relation to benthic responses

This was introduced as a new ToR. However, the consensus was these ideas this will be discussed separately among experts and a compilation of ideas (e.g. to support masters or doctoral thesis) will be stored in the share point for future initiatives.

Compile a list of scientific ideas to develop research Master's thesis projects and promote co-supervision activities within BEWG members

The ideas will be discussed as individual initiatives, depending on projects, funding available and as opportunities are advertised.

A suggestion was made to promote further integration across the BEWG and other relevant groups. Some revised ToRs are included in the BEWG new resolution 2021–2023. This suggestion would be added as a bullet point under ToR c) Benthos and legislative drivers.

7 Cooperation

7.1 Cooperation with other ICES working groups

ICES Working Group on Fisheries Benthic Impact and Trade-offs (WGFBIT)

An update on the activities conducted by the Working Group on Fisheries Benthic Impact and Trade-offs (WGFBIT), co-chaired by Gert Van Hoey was summarised at the meeting. This work will be closely aligned with the scientific work developed under the BEWG. Gert Van Hoey provided an update on the work and ongoing initiatives. For more details on the group ToRs, activities and contacts with other EG, visit their website: <https://www.ices.dk/community/groups/Pages/WGFBIT.aspx>

ICES Working Group on Marine Benthic and offshore Renewable Energy Development (WGMBRED)

Jan Vanaverbeke provided an overview of the ongoing work of WGMBRED. Four multi-annual ToRs (2019–2021) have been tackled through the last three years cycle, being the scale issues, the knowledge scheme, the network analysis and the identification of indicators.

For more details, please see: <https://www.ices.dk/community/groups/Pages/WGMBRED.aspx>

7.2 Cooperation with other benthic working groups

Laurent Guérin co-chairs the OSPAR benthic habitat expert group, in which some ICES BEWG experts are also members and share information at each meeting, and contribute to ensure coherence and avoid redundancies in respective works. An overview of the group work and ToRs was provided. These direct links will facilitate a direct cooperation and integration between both EGs.

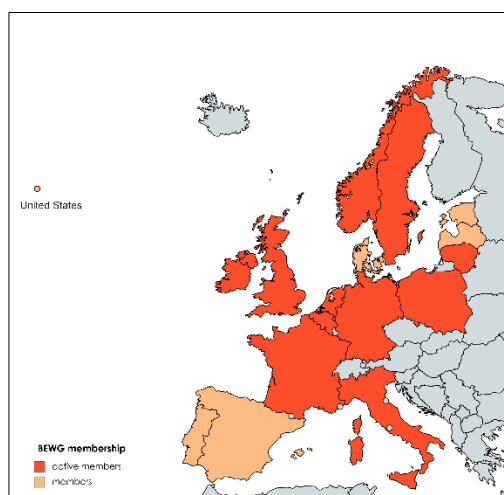


Figure 1. Countries that have experts in the BEWG.

Annex 1: List of participants

BEWG 2020 meeting

Name	Affiliation/ Country	Email
Jan Beermann	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research Germany	Jan.Beermann@awi.de
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BEWG 2019 meeting

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Annex 2: BEWG Resolutions

The **Benthos Ecology Working Group** (BEWG), chaired by Silvana Birchenough, 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 2018	14–18 May	Banyuls-sur-Mer, France	Interim report by 30 June	
Year 2019	6–10 May	Ulster, Northern Ireland, UK	Interim report by 30 June	
Year 2020	11–15 May	by corresp/ webex	Final report by 30 June	physical meeting cancelled - remote work

ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
A	Long-term benthic series and climate change 1. To identify methodological issues in long-term series comparability	The need for the BEWG to work on current tools and techniques associated with the understanding of natural variability and climate change on the benthos is of importance. There is a need to review and compile methodological issues associated with long-term series comparability in marine assessments.	2.1	1–3 years	Review paper on current methodological applications
B	Species distribution modelling and mapping 1. To report on ongoing case study: “Towards a benthic ecosystem functioning map: interregional comparison of two approaches	Distributional modelling (SDM) helps the understanding of the distribution of species and communities. These are considered to be robust tools in support of a scientifically-sound management of the marine ecosystem. While qualitative SDM (i.e. modelling the likelihood of occurrence of benthic feature) has been regularly applied, there is a need to focus on quantitative modelling techniques (e.g. modelling densities or biomass) over environmental drivers (e.g. sediment type, organic matter content and other relevant parameters) and processes. BEWG will report on the performance of different qualitative and quantitative species distribution modelling methods, e.g. methods validity and with hypothesis driven case studies to showcase the use, benefits and further gaps associated with these tools.	1.3; 1.5; 1.7	Year 1-3	Position paper (with a case study example).
C	Benthos and legislative drivers 1. To report on	A wide suite of benthic quality indicators were developed, intercalibrated and applied within the framework of several international regulations. At present, the most relevant directives within the North	1.5; 2.4	Years 1-2	Position paper

		the use of benthic indicators and ongoing initiatives	Atlantic realm are the Water Framework Directive, the Habitats Directive and the Marine Strategy Framework Directive. BEWG will investigate the Compatibility and complementarity within the use of benthic indicators and targets for management applications. Further work will concentrate on investigating the importance of species autecology in indicator development and application and review the development of effective monitoring programmes, e.g. design, harmonisation and quality assessments.		Years 1-3	Research paper(s)
	2.	Variability and expert judgement of benthic species tolerances/ sensitivities			Years 1-2	Review paper
	3.	To review the development of effective monitoring programmes, e.g. design, harmonisation and quality assessments (e.g. MPAs). Case study developed under the – Joint Monitoring Programme - JMP				
D	Benthic biodiversity and ecosystem functioning	Disentangling the link between biodiversity and ecosystem functioning is currently considered to be key to fully understand the health of marine ecosystems. This topic hence became a cross-cutting theme since the BEWG 2012 meeting. 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. This work has been an important topic and an overview of current and recent research gaps and priorities will be discussed. The ongoing discussion will be based on a conceptual perspective, BEWG will continue investigating the link between ecosystem functioning and ecosystem services.	1.3; 1.7; 1.9			
	1.	To report on the ongoing case studies to assess ecological responses across sediment gradients.			Years 1-3	Research paper to report on a selected case study.
	2.	To consider new functional indicator needs to support MSFD requirements.			Year 1-3	Viewpoint paper
	3.	To identify links between benthic functions and ecosystem services.			Year 1-2	Viewpoint paper
E	Benthic biodiversity	Understanding ecological issues associated	6.1; 6.2;	Years 1-3	Review paper	

	and conservation: to review the role of benthic ecology in MPAs to the development/proposal of MPAs and of how effective MPAs are going to be for the conservation of priority benthic species is key to support conservation and management strategies. This work has been developed to understand the different levels of protection (i.e. management measures) being applied within MPAs. The exercise will help to assess whether the designation processes in place are adequate to protect the species in need of protection, creating further repercussions to the 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.	6.4		
F	To explore the feasibility to undertake studies (e.g. laboratory or field experiments) to test ecologically relevant hypothesis in relation to benthic responses. 1. To explore funding opportunities and collaborative proposals for setting up and conducting experimental studies; 2. To compile a list of scientific ideas to develop research Master's thesis projects and promote co-supervision activities within BEWG members.	Conducting applied science to test direct hypothesis driven questions, which can help to support and validate dedicated case studies Similarly BEWG recognises the need to widen its scientific scope and a way to support this activity is by jointly supervising specific research projects. This type of further research will help for extending its remit, build dedicated set of skills and widen its influence across different networks. The BEWG also recognises the need to invite and include early career scientists in to our annual meetings, helping to shape the new round of ecologists.	tbc	Years 1-3 Review paper Year 1-3 Thesis preparation and invitation to meetings.

Summary of the Work Plan

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

Year 3	ToRs A., B.1, C.1-3, D.1-3, e.1, F. 1-3
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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). All issues mentioned fit the ICES Science Programme and are considered to be of high priority. The BEWG are active contributors and aim to report their outcomes directly to ICES in their annual report 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 groups 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 WGDEC, WGSFD, WGECO, WGMHM and WGEXT.
Linkages to other organizations	The group has had also interaction with OSPAR IGC-COBAM.