

## Theme session F

Bottoms up- approaches: the contribution of marine benthos over management, conservation and monitoring, taking stock and setting research direction

Conveners: Silvana Birchenough (Cefas, UK), Ingrid Kröncke (Senckenberg Institute and ICBM, Germany), Steven Degraer (RBINS, Belgium)

### Introduction

Benthic systems are recognised to be important ecosystem components as they contribute to the overall functional role of reworking of sediments, delivery of nutrients and food to higher trophic groups, habitats provision facilitated by engineering species and many other processes. Due to their low mobility and sessile habits, benthic species are great indicators of change, helping to signal distinct disturbance effects. It is essential to document and understand how benthos research has contributed over the many years to pressure-driven assessments (e.g. climate change and direct human activities), in support of conservation activities (e.g. marine protected areas (MPAs)) and in support of legislative purposes (e.g. Water Framework Directive (WFD), Marine Strategy Framework Directive (MSFD)). There is still room to scope which processes, and functions can be used to direct management and advice to advance the integration of benthic systems into wider ecosystem level assessments.

This two hours session aimed at providing an overview of the current ecological “state of the art knowledge” on benthic systems contributing to:

- The understanding of natural variability and climate and human pressures and monitoring to support legislative drivers;
- Conservation initiatives with current tools and using large scale applications (e.g. habitat suitability and modelling approaches);
- Lessons learnt from long-term assessments in support of management and advice (e.g. MPAs, developing indicators);
- Use of new tools for assessment and management (e.g. eDNA and potential new screening tools);
- Bringing the socio-ecological dimension for the study of benthic systems (valuation of services, bio-economic tools).

### Session format

The format of the session combined 9-minute oral presentations interspersed with 1-minute poster presentations. The session hosted a total of nine oral presentations and five poster presentations that were presented by both early career and senior scientists. Detailed questions were taken after each presentation, while the more

general questions were conducted with a highly participatory final wrap up discussion at the end of the session. The session was attended by approximately 70 attendees.

Overall, the session was well received, there was a mix of ecologists, modellers and conservation scientists. Participants were enthusiastic and actively contributed to the discussion topics. There was also an opportunity to disseminate the work of the ICES Benthos Ecology Working Group (BEWG) and to invite new contributors: two interested colleagues got in contact after the session to join specific ICES expert groups. There was a good number of new young benthos researchers in the auditorium, which provide promising outlook for future benthic research.

### **Taking stock**

The benthos is a key ecosystem component, and ongoing studies for understanding their role and contribution to marine ecosystems continues to increase across research and advice. The session however, identified several knowledge gaps which may be considered informative for setting contemporary research priorities. The main gaps are centred on the impacts of more recent human activities at sea, and equally on the need for a detailed understanding of the cause-effect mechanisms behind impacts or trends. There is a clear need to acquire an in-depth understanding of impacts and trends, helping to maximise the potential effects on benthic systems and the opportunity to use this knowledge to support ongoing and upcoming policy requirements and management frameworks.

Environmental monitoring programmes focused on benthos are now running for decades. However, there is still a debate on how to best achieve cost-effective and scientifically sound environmental monitoring programmes. Many (often legally dictated) project-oriented monitoring programmes fail to collect the critical data needed to be conclusive in a scientifically-sound manner. Integrated monitoring programmes within each of the individual project-oriented monitoring programmes are linked and complemented with integrative monitoring programmes. These have been shown to offer solutions, as demonstrated by the Dutch government-driven Wind op Zee Ecologisch Programma (WOZEP) monitoring and research programmes of environmental impacts of offshore wind farms. Monitoring effectiveness and efficiency can also be increased by a 'fit-for-purpose' design, based on knowledge on the spatial distribution of the marine resources as demonstrated for Canadian benthos monitoring programme, or by making use of a detailed understanding of the spatial distribution of the benthic sensitivity and vulnerability to trawling of megabenthos (example: Bay of Biscay) and vulnerable marine ecosystem (VMEs) (example: North-Atlantic).

Novel techniques were demonstrated to be useful to collect and interpret new data, but also to re-explore historic data. Ever more attention is paid to setting up marine/benthic observatories as to systematically collect benthic data over a time period longer than what usually goes for project-oriented monitoring programmes. Long-term ecological research (LTER) sites which now also start comprising the marine environment are promising here and may complement or strengthen existing long-term time series as exemplified for the North Sea.

Much different from the type of analyses that used to be done mainly targeting the observation of change in structure, historic and long-term data, as well as newly collected data are now analysed for the functional aspects, including how non-indigenous species have impacted ecosystem functioning, the feeding ecology of benthos-feeding fish in the Wadden Sea marsh creeks. Novel analytical techniques for benthic ecosystem functioning interpretation were presented, as exemplified by a differentiation in trends among different areas (in Germany) with some benthic ecosystem shifts observed coinciding in time, a mechanistic analysis to support the development and further understanding of the ecosystem functioning as illustrated by long-term trends in food webs, food web analysis conducted with several (relatively) new tools as ECOPATH, ECOSIM, ENA and SIA, and sensitivity assessments based on the biomass-longevity distribution in relation to stress from bottom trawling. Focusing on the functional aspects of the benthic ecosystem has good potential to better address marine management challenges ever more targeting ecosystem functions, processes and services, helping to support an “in-depth” understanding of the benthic ecosystem.

#### **Setting research direction**

- There is a clear need to support the development of a cost-effective and targeted design of monitoring programmes from an integrated perspective. A suggestion will be for ICES to consider this task and to provide the benefits and advantages of a well-coordinated and integrated monitoring programmes, helping to provide cost-effective, scientifically driven and fit-for-purpose monitoring activities rather than a large number of project-oriented monitoring programmes. ICES could organise a targeted workshop with benthic experts and build a bottom up approach with other EGs to provide a well-co-ordinated ecosystem-based monitoring programme.
- The study of benthic systems has increased rapidly, but there are still several gaps in the level of detail required on species sensitivities. This lack of knowledge provides an issue as several benthic indices and tools are still heavily reliant on expert judgement. ICES could support work on dedicated life-history traits and species sensitivities, with the view to host a dedicated data workshop. This work could be used to support reliant R&D and advisory requests, ensuring that the data used on indices calculation has been validated.
- If benthic research and advisory requests increase within ICES, there will be a need to up-date and provide further information on benthic habitats and species (shallow to deep water habitats) to support the ICES ecosystem overviews. A recommendation to ICES is to continue to work with relevant EGs (e.g. BEWG, Working Group on Biodiversity Science (WGBIODIV), Working Group on Marine Benthic and Renewable Energy Developments (WGMBRED), Working Group on Deep-water Ecology (WGDEC)) to support these targeted advisory requests with the most up-to date science developments.

In conclusion, the session gave a good overview on the status of ecological research in relation to benthic systems. The session revealed a wide variety of classical and new approaches being tested in benthic research to address urgent priorities to provide the much-needed science-based evidence to support conservation and management requests. There are still clear gaps and recommendations from this session that could be considered under the BEWG in collaboration with other expert groups to ensure that the dedicated recommendations are further explored within the ICES community.