Theme session E

Cumulative effects assessment in the marine realm: approaches, examples and future needs

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Marine ecosystems are increasingly threatened by the cumulative effects of multiple human pressures, relating to both extractive and non-extractive uses. Cumulative effect assessments (CEAs) are needed to inform strategic planning and marine conservation within an ecosystem-based management framework. CEAs are defined as holistic evaluations of the combined effects of human uses and natural processes on the environment, and constitute a specific form of environmental impact assessments. Despite their utility and critical need, the operationalization of CEAs in marine ecosystems remains one of the key challenges for scientists and policy makers worldwide. Therefore, the main aim of the session was to scope for approaches, examples, and future needs to improve the alignment of CEAs and management processes.

Overall the session was well attended (approximately 120 attendees) and accommodated 12 oral and 4 poster presentations. Based on these contributions and the closing plenary discussion four general themes have emerged:

1) Cause-effect pathways – the challenge of accounting for complexity
2) Sources of uncertainty in CEAs
3) Need for coherence of CEAs
4) Relevance of CEAs in management processes

In the following, the four general themes and associated scientific challenges are described, along with recommendations that address the potential role of ICES in enhancing and facilitating the operationalisation of CEAs

1) Cause-effect pathways – the challenge of accounting for complexity

Cause-effect pathways form the centre of any CEAs. Cause-effect pathways of multiple human uses on sensitive ecosystem components are often complex, involving a combination of additive, synergistic and potentially antagonistic effects on ecosystem components. This complexity is caused by the high level of connectivity of ecosystems or underlying dynamic biophysical processes. The session revealed different approaches to identify key cause-effect pathways comprising e.g. complex linkage tables, correlative analysis of empirical data, mechanistic food web models informed with spatial-temporal databases, statistical models or mental models developed with key stakeholders. A common issue was the reduction of complexity of the representation of pressure-ecosystems state linkages. The emerging scientific challenges were:

i) accommodating non-linearity in cause-effects pathway models/methods;
ii) upscaling and down scaling of linkages
iii) accounting for feedbacks, in particular from the natural to the human sub-system
iv) modelling multi-scale processes and responses; scales mismatch
v) acknowledgement of temporal scales
vi) necessity to go beyond the additive effects simplification and accounting more for synergistic and antagonistic effects

2) Sources of uncertainty in CEAs

Many authors recognised and highlighted in their studies the need to deal with uncertainty in CEAs. The availability and treatment of human pressures data emerged as underestimated resources of uncertainty in CEAs. Specific challenges identified were:

i) quantification of pressure intensities at different spatial resolution
ii) representation and communication of uncertainty
iii) uncertainty in baseline data (such as habitat maps, depth maps, distributions of species, etc.)

3) Need for coherence of CEAs

The session further identified the need for coherence in the use and application of tools as an important topic. The idea of a typology of tools, according to various needs and management context emerged. Although a unified and broadly applicable CEA methodology is most probably not feasible, the improvement of guidelines and best practices to facilitate CEA applications are urgently needed. As yet, CEAs are seldom linked to real-world management processes. More precisely the related tasks involve:

i) development of a robust typology of tools while allowing flexibility to better fit to social-ecological contexts
ii) definition of standards on how to proceed with CEAs
iii) definition of a roadmap on how to tailor CEAs to be of better use for management advice

4) Relevance of CEAs in management processes

The session reinforced the relevance of CEAs in management and decision processes. Multiple policies and international regulations drive the need for CEAs to support the management of combined and multi-sectoral impacts of human uses on marine biodiversity and ecosystem functioning. Hence, CEAs are seen as key components in marine spatial planning (MSP) and conservation planning initiatives. Despite their broadly recognised relevance no success story describing the delivery of CEA results into management processes could be reported during the session. The respective challenges encompassed:

i) the general difficulty communicating CEA results to stakeholders
ii) the need for adaptive management to be able to accommodate CEA results
iii) the urgent need of success stories describing the use of CEA results in decision making processes
iv) the need to communicate to stakeholders the added value from including other sectors in integrated evaluations (so they see it as a positive element and want to participate/be part of it)
v) scoping for the capability of stock assessment models to accommodate CEAs and the other way around

Recommendations for ICES

The following recommendations address the potential role of ICES in enhancing and facilitating the operationalisation of CEAs:

- ICES could contribute to the development of coherence and standards in CEAs by facilitating exchange with relevant working groups and the alignment of activities and the advancement of science products.
- ICES could play an important role in engaging stakeholders in the use of CEAs by incorporating CEA results in the description of ecosystem state.