

Theme session C

Ecosystem monitoring in practice

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In recent years there has been a shift in focus of marine monitoring programs that have traditionally addressed particular ecosystem components like biogeochemical parameters or commercial fish species stocks towards assessing the entire ecosystem. Accordingly, a range of methods and equipment is employed to measure diverse ecosystem components and to be able to detect changes, monitor key processes and observe the whole ecosystem in general. Despite recent advances in monitoring techniques, the need for continued development of tools and techniques remains. Working towards a more holistic approach and improved coverage of components at higher spatio-temporal resolutions, there is a need for creative and alternative use of available resources – including personnel, ship time and data, as well as research platforms, vessels, and remote sensing, among other things.

The session was attended by approximately 50–70 participants. Contributions included 14 (15) talks and 5 posters and addressed three core areas of innovative ecosystem monitoring techniques: (1) novel methods and datasets to be applied/examined when following an ecosystem approach in monitoring; (2) studies recently or currently conducted applying measures to follow a more holistic approach to ecosystem monitoring; (3) new joint survey programs focusing on combining or expanding existing surveys to broaden measurements of ecosystem parameters and e.g. marine strategy framework descriptors in an ecosystem survey.

The two opening papers (C:02, C:05) highlighted the necessity to expand the use of existing databases, to make time-series more openly available and to increase interactive sharing of data. The catch phrase for jointly used databases as eponymous for one presentation was “collect once, use often” and related to the assessment of hitherto un-analysed trends in indicators like phytoplankton, zooplankton, salinity, nutrients, non-indigenous species etc. Paper C:07 showed that when following an ecosystem approach in surveying areas with novel methods, historic data to compare new findings with are of crucial importance. Additionally, it was shown that monitoring vast spatial areas requires large monitoring programs at a sufficiently high spatial resolution. Paper C:08 demonstrated how existing physical and oceanographic data can be used for seasonal ecosystem forecasts and to predict distribution patterns of marine organisms to optimize survey design. However, it was pointed out that interdisciplinary communication and discussions about data collection, use of data for modelling and corresponding policy decisions remain a challenge. The last paper (C:03) of the first session section provided a summary of the 2015 ICES WGFAST (Working Group on Fisheries Acoustics, Science and Technology) meeting and pointed out how modern acoustic technologies are employed to work towards an ecosystem approach in scientific surveys and to observe the ocean resources on multiple scales.

The second section on the use of alternative survey platforms (i.e. commercial fishing vessels) was opened by Paper C:12. It was presented how traditional surveys can be

combined with auxiliary survey segments and data to optimize the survey design and increase the spatio-temporal coverage of surveys. Papers C:09 and C:01 showed examples of interdisciplinary monitoring and the additional sampling of further measurements to introduce the ecosystem component into existing monitoring programs, while simultaneously highlighting resulting challenges such as seasonality of sampling. Paper C:14 showed how through the use of auxiliary survey platforms (chartered fishing vessel) and through the concurrent monitoring of both environmental and biological/multispecies parameters the spatio-temporal coverage of a survey can largely be increased to derive estimates about medium- to long term changes in physical properties of large areas and their influences on habitat quality and species distribution. The final paper in this section (C:13) showed how novel, non-invasive methods and alternative research platforms (e.g. unmanned aerial drones in combination with submerged optical systems) can be used to assess nursery habitats of marine species in areas that would be inaccessible to traditional sampling operations or where the use of traditional sampling methods would be detrimental to ecosystem health.

Within the final section on possible joint monitoring programs as an approach to integrated ecosystem monitoring, Paper C:10 highlighted the challenges of ecosystem surveys in developing countries. Examples of various levels of data collection were shown (e.g. hydrography, plankton, fish, predators, plastics etc.). Key challenging factors identified were time management, sampling frequency and international cooperation. The three papers C:06, C:11 and C:04 focused on prerequisites and potentials to integrate existing survey programs into monitoring programs that allow for the collection of additional relevant ecosystem parameters, e.g. marine strategy framework directive (MSFD) indicators. This was presented as added value to existing surveys, as an effective alternative to new surveys. Results from a workshop with participants from different marine sectors were presented, demonstrating how forces can be joined to address different MSFD descriptors in existing surveys. Challenges highlighted were limited availability of resources during existing survey programs, limited communication across entities involved as well as a clear, concise and precise definition of actual survey objectives.

During the discussion, the main topics of the session were discussed and the need for continuous, further development of currently available survey techniques was highlighted. The use of alternative platforms (e.g. chartered fishing vessels, ferries, etc.) providing data on a more continuous basis, when compared to the snapshot like picture resulting from traditional surveys, was received as an important tool to improve the timing and design of current surveys. A further highlighted challenge was the adequate use of already available data. A vast amount of information is currently being recorded and stored routinely, but largely remains underused, once more "collect once, use often" was stated as a leitmotiv. Further, it was generally agreed that there is an urgent need for more interdisciplinary cooperation and communication. Besides these challenges the session managed to highlight some innovative approaches addressing current needs in state-of-the-art monitoring of marine resources. It was shown that through out of the box thinking and actions, innovation can be made possible and lead towards an improved understand of the marine ecosystem.

Paper C:13 (Kilfoil *et al.*) was given an Honourable Mention in the category for Best Oral Presentation by an Early Career Scientist.