

Theme session L

Ecosystem monitoring in practice

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Traditionally marine monitoring programs have focused on particular ecosystem components such as biogeochemical parameters or commercial fish and shellfish species for which stock assessments are carried out as a basis for fisheries management advice. During recent years many of these monitoring programs have changed focus to study the whole marine ecosystem by measuring a multitude of ecosystem components simultaneously to be able to detect changes and monitor key processes, and the status of the ecosystem in general. This is also expected to support the ICES Action Areas “Marine Strategy Framework Directive (MSFD)” and “Integrated ecosystem assessments (IEA)”.

Non-standardised sampling methods lead to irregular datasets that are difficult to synthesize. This adversely impacts the quality of databases and subsequent products. This is particularly true in the case of zooplankton, which although recognized as sensitive to environmental changes and an important link to higher trophic levels such as fish, are not routinely sampled as part of fisheries and other monitoring surveys. We therefore need to adapt our thinking on monitoring in general and how to promote an integrated approach to the collection of data (zooplankton and others) for fisheries and environmental monitoring requirements.

The session invited contributions on proven concepts, best practices, and novel approaches with respect to the following topics:

- Data compilation: developments in integration of data, combined presentation of data from multiple sources, data mining, visualisation of results.
- Calculation of derived variables based on data from multiple sources, e.g. primary and secondary production in marine systems, relationships between food availability and consumption.
- The use of automated devices: automated calculations from automatic measurements, and automatic data integration.
- Presentations of holistically orientated methods for accurate and precise quantification of process governing ecosystem functions for optimal ecosystem balancing and management.

Contributions

24 abstracts were submitted, covering the four points described in the synopsis. All abstracts were of sufficient standard to be selected and following a discussion among the 3 conveners, we selected 14 abstracts for oral presentations and 10 as poster. The session was divided into 3 parts over 2 days. Attendance ranged from 25 to 50 people. Oral presentations were of a very high standard, covering the following subjects:

- A zooplankton underwater observatory, part of the Coastal Observing System for Northern and Arctic Seas (COSYNA), which monitors multiple ecosystem components in an integrative way, using a suite of sensors and platforms.
- The use of artificial intelligence tools for the oceanography and conservation.

- An integrated plankton sampling and imaging instrument, capable of taking and analysing images of zooplankton from a source of continuously flowing water.
- The use of underwater video recordings to reconstruct biological networks, and integrate these with information on environmental characteristics and fishing pressure, as a tool for fisheries management and conservation.
- The use of automated UAV survey data with image processing algorithms, to quantify coral and invertebrate densities in shallow water marine environments.
- The integration of bottom-trawl and acoustic data, to study the 3D spatial distribution of fish.
- The derivation of plankton size distributions and normalised size spectrum from a huge number of data obtained from several sources (pump, net, optical and acoustic methods); a useful tool for modelling plankton communities and larval fish prey fields.
- The use of statistical analysis to extract information from a combination of 100+ long-term time-series data, and synthesize those large datasets and define specific ecosystem interactions.
- The potential pitfalls of using the multivariate Principal Component Analysis for the analysis of multiple time-series, and how to test the validity of interpretations resulting from this approach.
- The development of indicators from multiple monitoring surveys, for ecosystem-based management.
- How to manage, integrate and use historic and ongoing data products: a description of the Northeast U.S. shelf marine ecosystem monitoring programme.
- The integrated coral observing network: a web-based product which features coral reef information from a combination of remote sensing, instrument and in-situ monitoring stations. This product allows the production of ecoforecasts of bleaching and other environmental marine events, in near-real time.
- A simple approach for data compiling and presentation as a dashboard for fisheries management. This holistic method generates integrated visions of complex systems, allowing a more explicit presentation of the data than the juxtaposition of a series of different tables.

Poster presenters were given the opportunity to present their work in a 3min time slot, but few presenters took this opportunity as many had already left at the very end of the conference.

Outcomes

All presentations were followed by discussions on how to improve monitoring of our marine ecosystems, work better together on taking our technologies further and working holistically on data management. Main questions were asked about how to cope with increased data flow resulting from automated technologies, and – as in previous theme sessions on the same topic – on issues around interoperability of data sets originating from different sources. The discussions benefited from the presence of the chair of the ICES Data and Information management group (DIG), and our expectation is that some of the topics will be included in the future work of this group.

The presentation by Kilfoil J.P. et al. “Moving beyond diver surveys: Automated AUV survey data extraction to quantify coral and invertebrate density in shallow-water marine environments” was recommended by the conveners for the Early Career Scientist best presentation award.