ICES Theme Session G

Practical advice for implementing marine policy: combining ecosystem and societal indicators in stock and ecosystem assessments

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Theme Purpose

Adopting ecosystem approaches for managing the sea and its living marine resources requires practical methods to translate information on environmental, ecological, and societal processes into the tools used to provide scientific advice for management. Although the use of indicators to describe both the status of marine ecosystems and the pressures imposed by human activities on these ecosystems has received much attention, there still is a need to better understand how the diversity of methods and indicators can be combined and applied to provide advice that has an integrated perspective across management objectives, and for what situations certain approaches for including societal and ecosystem indicators in governance and policy are most appropriate.

Across a range of marine ecosystems, we welcomed papers on the following topics: (a) Methods for including environmental, ecological, and societal information in stock and ecosystem assessments; (b) Performance of ecosystem indicator-based control rules and reference points; (c) Comparison of indicator-based assessments with traditional stock assessment approaches; (d) Defining management-relevant societal indicators of human activities and their drivers that cause pressures on the state of the marine environment; (e) Using information from socio-economic indicators to inform policy and scientific advice for fisheries and ecosystem-based management; and (f) The role of different types of information in the policy process and the information needed to prioritize among management actions.

During the session’s three days, a total of 46 oral presentations were given, with an additional two poster presentations. Oral presentations were grouped into subthemes based on resemblance. There was substantial time afforded to discussion, with much participation from session attendees. Attendance throughout the session was high, with an estimated average of 80 participants.

Developing and linking societal and ecological indicators

The opening paper (Grimvall) reminded us that societal indicators should not be limited to a treatment of effects. Instead, for management purposes it is the driver perspective of actors and their behavior that needs more attention. Further, the behavior of actors can change dramatically, necessitating systematic data collection to understand changes in system pressures. Consequently, indicators of environmentally smart behaviors of actors are needed as well as adequate methods for system analysis. Demonstrated throughout the session, there was distinct interest in trying to include societal indicators in advice for living marine resource management, and authors provided numerous analyses to suggest indicators. However, there was little offering of practical methods for how this would be done. Several authors provided papers that focused on describing development of indicators, with an emphasis on socio-economic indicators relating to fisheries. One method designed societal indicators of drivers for nutrients related to eutrophication. Life cycle analysis applied to fisheries provides opportunity to broaden the perspective of fisheries management (Hornborg) by considering energy use required by multiple sectors for food production. These analyses quantify tradeoffs among industry sectors associated with fisheries food production, not just those directly involved with fishing. Social impact assessments regarding vulnerability and resilience of communities suggested a need for analyses at multiple scales. Fuel use/consumption appears to be a useful economic indicator for fisheries when assessing tradeoffs among gear types, though further exploration related to costs seems needed.

Another question raised was how to define reference values for indicators and in identifying thresholds. Methods such as time series analysis and gradient forest regression trees appear promising for detecting multivariate responses of indicators to system pressures. Examples provided focused largely on ecological indicators, with anthropogenic pressures represented as fishing activity. However, authors did suggest that these methods could be applied with a broader suite of indicators. Defining threshold values for indicators and how they relate to management objectives is crucial for including this information in management frameworks. Rice stressed that it is important to understand how values for indicators reflect (or do not) desirable system states and behaviors. Dankel illustrated how uncertainty can be represented when using indicators as part of fishery decision rules.

Indicators in stock and ecosystem assessment models

An overview of fisheries modeling approaches for including environmental and ecosystem information in single- and multispecies assessments (Collie) served as a good introduction to the second day of the session. Several presentations focused on including environmental information in stock assessment analyses, with demonstration of improvement in model fit and structure (Schirripa), and state-space methods development for inclusion of additional information. Later presentations expanded scope to multispecies assessments and testing given trophic interactions and climate-driven recruitment and growth. Presentations in this section focused on operationalizing methods for accounting for ecological and environmental factors within current frameworks for providing advice. While such methods seem appropriate for including indicators of the effects, e.g. of trophic and environmental effects on the population dynamics of managed species, and for demonstrating consequences of these effects on typical fisheries economic indicators, it was not clear how a full range of societal indicators could be included in these papers.

Risk analysis

Quantitative and semi-quantitative risk assessment methods offer potential for integrating different types of information at scope and scales larger than that of stock assessments. Current practical methods for indicator scoring and trend analysis can be used effectively (Gaichas) to summarize ecosystem status and risk to multiple pressures and provide direction for management; these tools are available and can be used in practice. Some work still needs to be done to consider how some societal indicators can be integrated into ranking and scoring systems but this exercise seems doable. Papers on maritime spatial planning analyses demonstrated the use of these methods to identify areas most susceptible to pressures, and to demonstrate consequences associated with spatial management scenarios for multiple sectors. Discussion regarding the value of maritime spatial planning suggested there is a need for more integration across sectors.

Testing indicator performance

To use indicators directly in fisheries management advice requires some measure of their performance to understand the benefits (or otherwise) of adopting these methods. Santiago illustrated this with a case study for Galicia showing how fishing activities can be used to analyze tradeoffs between sectors. Management strategy evaluation (MSE), a simulation method for testing and comparing management strategies, is a powerful approach. Fay showed that simple inclusion of indicators in fisheries control rules could improve management performance in the Northeast US and that this analysis can be used to address system-level tradeoffs for societal and economic indicators through coupling of ecological and economic models. Application of bio-economic models for fleet dynamics (Carpenter) suggested that using socioeconomic criteria when allocating quota could change results in terms of rent and distributions of earnings. Similarly, spatially explicit analyses using economic incentives provided better explanations of stock assessment data (Simons). Rindorf used MSE to compare strategies that reflected multiple objectives for a single fishery, and identified the areas of ecosystem uncertainty that had the largest magnitude of effect on socio-economic indicators. It is clear that MSE offers potential for testing the use of societal information in addition to more complete ecosystem monitoring data in decisions. Applications discussed in our session need more input from social scientists and further development of the human models in the analyses, facts recognized by the speakers. MSEs for living marine resources that have included more detailed human behavior models have been conducted, suggesting pathways for future application in the ICES community; examples were not among those presented in this session.

Indicators in decision-making, stakeholder participation

Stakeholder participation was emphasized to reflect multiple and possibly conflicting priorities for marine management. When faced with such challenges, frameworks for identifying solutions that integrate all these perspectives in the decision process are needed. A simple approach was presented by Duggan for determining the relevance of indicator (biological and economic) information based on weighting of stakeholder preferences for alternative management outcomes associated with indicator status. A formal application and testing of the approach is needed, but it offers good potential. Thebaud presented outcomes of a true stakeholder participation process that attempted to incorporate the relative importance of economic valuation, ecological and socio-economic ecosystem indicators through a multicriteria application (AHP) in Australia. Preferences were compared between policy makers and the public, suggesting that decision makers had more of a conservation tendency whereas the general public tended to have a more economic focus when weighing options. There is therefore a potential for mismatch between those making decisions and public interests, perhaps owing to the implications of decisions for existing legislation rather than a broader perspective on societal importance of issues. There is a need for integration across stakeholders and an influence of demographics on preferences for the objectives of management. An example of management using consensus based decision-making was provided for the Antarctic on a description of CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources, Nilsson). The emphasis in CCAMLR is on engagement and interaction among many nations. Fish are normal, but fisheries are post-normal. The need to apply post-normal science approaches that highlight integration of uncertainty into both system status assessment and management was introduced by Dankel. The NUSAP framework that fits under a post-normal approach for including more information in the results of fisheries stock assessments was presented with the intent to highlight the need for methods that try a different approach. Another paper emphasized the need for time and effort to understand how different stakeholders interact and cooperate to identify conditions for success of co-management approaches that integrate the societal context of ecosystem-based management by including multiple stakeholders in decision processes. Immediate discussion following these papers included an important point, that stakeholder engagement and inclusion of societal information (both drivers and pressures in addition to impacts) ought be emphasized as a core component of the management decision process, and not as an add-on.

Discussion and paper planning

The session ended with a productive and engaging discussion that followed from the final set of talks. Of interest was how ICES could continue to develop a platform for interaction with social scientists and other disciplines. It was noted that the ICES strategic plan emphasizes that such engagement is needed. Our session was experienced as a relatively unique opportunity for discussion of the issues associated with including societal information in marine policy and stock and ecosystem assessments. There is much support from all scientists involved for the importance of this information to be included, and the diversity of presentations represented the need to grapple with this question from multiple angles; we need operational methods for integrating information into tactical and strategic management advice, but also need to think about how our institutional frameworks facilitate interaction and allow for broad perspectives when defining issues of importance for living marine resource management. We believe our session provided some answers, with some instances of practical applications for inclusion in advice, but also raised many questions,. Perhaps more importantly, it highlighted the need to really grapple with these issues; policy decisions are being made with or without this information, we might not have the answers yet but require tools today to operationalize these preferences. A small subset of session participants agreed to work together on preparing a manuscript for submission to the ICES Journal of Marine Science that synthesizes the issues raised during the session and provides participant (and organizer) perspectives on ways forward / issues remaining that were highlighted over the three days.

Conveners’ own conclusion of the session

The session dealt with issues in focus of the ICES strategic plan. One conclusion is that integrating knowledge from different sources, e.g. natural science or social science, necessitates compatibility. This may require people that have been involved for a long time to adjust and reformulate their work and results. This integration process for management purposes has only just begun regarding marine ecological and societal knowledge. Another conclusion is that there is a considerable amount of research (data and knowledge) regarding fish and indicators related to marine ecosystems in comparison with work describing societal drivers. Consequently researchers focusing on the latter do not have equal access to knowledge platforms for their communication. On the other hand we observe that many tools and methods are already available that can be applied in daily practice.

Societal indicators include two important but different perspectives that should not be confused: society as the cause to marine environmental changes, and the effects on society from marine environmental problems. To involve more scientists from various disciplines into marine issues it is necessary to invite these societal scientists and provide platforms for knowledge exchange. We believe ICES can play an important role in facilitating more interaction between scientists from multiple disciplines and providing forums for integration of available knowledge into decision making. Including decision-makers and managers in scientific meetings that discuss the implications of management scenarios, such as the ICES ASC, is needed.