Theme Session E
Marine spatial planning in support of integrated management–tools, methods, and approaches (E)

Co-Conveners: Stuart Rogers (UK), Robert O'Boyle (Canada), Glen Jamieson, PICES (Canada) and Tana Worcester (Canada)

Marine spatial planning (MSP) is being used in an increasing number of jurisdictions as part of a strategic approach to achieving sustainable development in the marine environment. While the concepts of integrated management (IM) and MSP are now often included in marine policy, it is still unclear how they will be practically implemented. Conservation, conflict resolution to address multiple human uses, and implementation of an ecosystem approach to oceans management are all important drivers for MSP. The most obvious elements of MSP include marine protected or spatially regulated areas designed to meet one or more objectives of IM, and assessment of the interactions between multiple sectors. ICES science has an increasing role to play in the development of methods to support MSP.

This theme session explored the latest developments in MSP under four topics: criteria for selection of planning approaches, human activities and their interactions, guidelines for the planning of MPAs, and case studies to describe recent experiences of MSP.

A number of presentations in this session identified the need for a common set of objectives to guide the planning process. It was generally recognised that ecosystem objectives (also referred to as environmental or conservation objectives) and their associated reference levels should be determined by scientists and should be non-negotiable, while determination of socio-economic objectives will require significant input and consultation to address the competing interests of different stakeholders. The need to evaluate multiple and potentially conflicting objectives, and the role that society will play in the resolution of these interactions, will involve the increased use of interactive web-based tools to communicate to a wider community.

Identifying the appropriate ecosystem components for conservation can be a challenging task. In Canada, a structured set of guidelines have been developed to identify ecologically and biologically significant species, areas and community properties within each of its distinctive Large Ocean Management Areas. In Norway, particularly valuable areas are identified based on their importance to biological production, biodiversity or as key habitats to threatened or vulnerable species. Use of risk assessments to identify priority activities and components for management action was also highlighted, with some good progress demonstrated in the UK, Australia and North America in both data-poor and data-rich environments.

Another common theme was the use of spatial tools and analysis to investigate the response of species and habitats to both human and natural disturbance and to explore concepts of sensitivity, vulnerability, and recoverability. For example, models incorporating spatially defined oceanographic parameters such as depth, substrate type, and bottom temperature were used to characterize benthic habitats and predict the sensitivity of these habitats to human disturbance (including potential rates of recovery). These types of tools are now being used to identify priority areas for conservation, and may have future application elsewhere. Spatial tools can also be used to help maximize ecosystem benefits (i.e. maintain ecosystem function or goods and services) while minimising societal costs, thereby optimising the provision of relevant management measures.

Technological advances are improving our ability to evaluate species distributions (e.g., acoustic methods, tagging and otolith analysis), describe habitats (e.g., multibeam mapping, habitat modelling), and assess human impacts (e.g., vessel monitoring systems or VMS). This

is enabling the better selection of indicators that show responses to impacts and the recovery of systems, as well as the development of reference levels based on analysis rather than *ad-*

These findings can be mathematically combined and visualized in one map (Fig. 2 a).

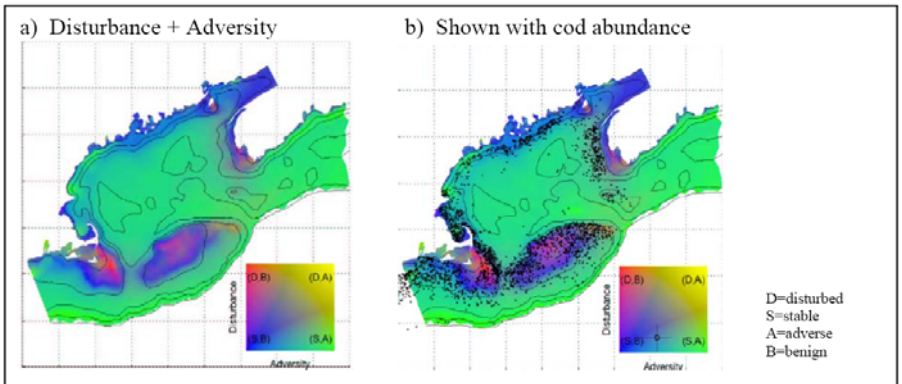

Figure 2. Adversity and disturbance can be presented together (a) using a habitat template matrix to map habitat types according to these two properties. The resultant habitat map can be overlain with other features such as abundance of managed fish species (b). X-axis is latitude, and Y-axis is longitude in degrees. ICES CM 2008/E:23 Habitat Suitability Modeling using the Kostylev Approach in Support of Fisheries Management

hoc selection. Allied with the development of common standards and best practice in some areas, this supports more coherent planning in an ecosystem context.

While much of the session focussed on the use of spatial planning to address fisheries impacts and issues, spatial tools were also demonstrated for aquaculture, shipping and coastal management concerns. For example, MSP has been used to reduce the spread of disease

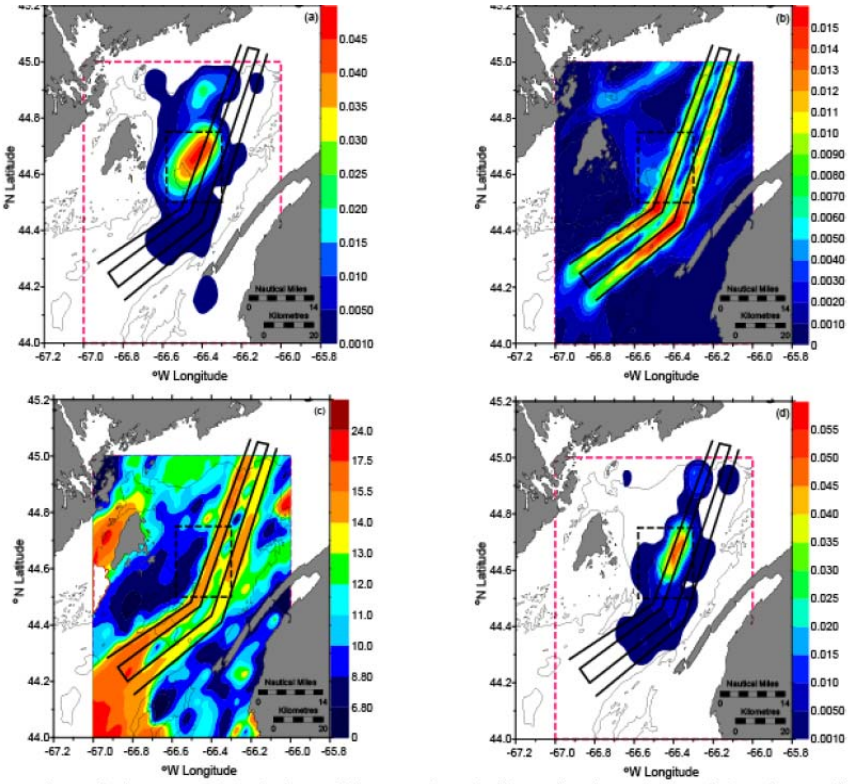

Figure 2. Bathymetric (100 m resolution) charts of the Bay of Fundy illustrating the study domain (– –), Canadian Right Whale Conservation Area (– –), and original traffic separation scheme (——) (inbound lane to E and outbound lane to W) and showing the relative probability of (a) observing a right whale, (b) observing a vessel, (c) average vessel speed (knots) and (d) relative risk of a lethal collision between a vessel and a right whale. Note panel (c) is colour-scaled to match that of lethal collision as a function of vessel speed shown in Figure 1b (adapted from Vanderlaan *et al*. 2008). ICES CM 2008/E:01 A practical example of a successful strategic approach to marine spatial analyses and minimising spatial conflict: How not to kill whales with vessels.

between aquaculture sites, has helped with appropriate aquaculture site selection, and has been used to reduce interactions between vessels and whales. The integration of information from a broad range of human pressures will be essential for successful cumulative effects assessment. Several talks provided examples of the different types of management tools that can be applied within the marine environment, including area-based and seasonal closures, as well as gear-based technical measures (e.g., acoustic deterrents, weighted fishing lines) applicable for mobile species with no fixed spatial location.

The extensive use of geo-referenced data to produce maps, develop models and tools, and identify and assess habitats and/or sectoral interactions is now common, and will become increasingly important as plans become more multisectoral and complex.

The development of MPA networks continues to be a key focus for many scientists and technical experts. While MPA network design and evaluation (e.g., determining the degree of connectivity, representativity, or coherence of sites) remains an ongoing challenge, a number of case studies and approaches (e.g., site-selection algorithms such as MARXAN and Zonation, simulation models such as ISIS-Fish, generalized additive models, and GIS) demonstrated significant progress. However, it was cautioned that site-selection algorithms such as MARXAN and related software can generate multiple solutions to the same set of objectives, showing that it is important to clarify objectives and related input criteria at the start of the process. Rather than being used in a prescriptive manner, these tools can be used to generate discussion among stakeholders regarding the costs and benefits of various management options, leading to more informed decision-making.

Examples of how MSP has worked in different regional seas or national waters highlighted the importance of clarifying its purpose, and to get acceptance of the process from all key stakeholder groups. Although the focus of the session was marine ecosystems, it was noted that land-use plans that manage important watersheds must also be accounted for when developing marine plans, particularly in coastal areas. There was a general feeling that integrated planning in both terrestrial and marine ecosystems is increasingly necessary in many near shore areas in particular, and that the necessary datasets, tools and approaches to allow this are in place. Required next steps must be political and legislative support, and broader stakeholder engagement.

Conclusions

This theme session was the first opportunity in ICES to discuss integrated, multi-sectoral issues in the context of marine planning. As expected from this largely ICES audience, many of the presentations explored the interaction between the ecosystem and fishing. As the single largest impact in many of our regional seas, this is understandable and the emphasis is to be expected. In the future, however, ICES will increasingly be required to assess ecosystem impacts of many competing sectors simultaneously; the implications for how science addresses these issues are considerable.

A point frequently made in this session was the pressing political need for establishment of meaningful MPA networks. MPA planning is often conducted parallel to, but separate from, other marine planning initiatives rather than as part of a truly integrated approach to marine management. This can lead to what was described as the ‘Swiss cheese’ approach to management, in which conservation efforts are increasingly focussed on a few sites. We currently lack the models and understanding required to simultaneously address the needs of, for example, renewable energy, fisheries and conservation. Development of more quantitative approaches for assessing risk, i.e., sensitivity and exposure, and the increasing incorporation of hydrodynamic modelling to assess spatial connections are other common emerging themes. The use of such risk-based assessment methods, which target management effort at priority threats, is a developing field and should be considered in future ICES sessions.

Stuart I. Rogers, Centre for Environment, Fisheries & Aquaculture Science Lowestoft Laboratory, UK, e-mail: stuart.rogers@cefas.co.uk

Robert O'Boyle, Fisheries and Oceans Canada, Bedford Institute of Oceanography, Canada, E-mail: bcubed@accesswave.ca

Glen Jamieson, Fisheries and Oceans Canada, Pacific Biological Station, Canada, E-mail: jamiesong@pac.dfo-mpo.gc.ca

Tana Worcester, Fisheries and Oceans Canada, Bedford Institute of Oceanography, Canada, E-mail: WorcesterT@mar.dfo-mpo.gc.ca