Fisheries and Oceans Canada's Marine Environmental Quality (MEQ) approach in the determination of marine indicators

Glen Jamieson[1], Brenda McCorquodale[2] and S. Diggon[2]

[1] Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC, V9T 6 N7, Canada
[2] Fisheries and Oceans Canada, Port Hardy, B.C., V0N 2P0, Canada

Abstract

Canada's Oceans Act established three processes to achieve ecosystem-based management (EBM): establishment of integrated management, marine protected areas, and marine environmental quality (MEQ) monitoring. MEQ monitoring will assess effectiveness of existing levels of protection in achieving objectives established for conservation in both marine protected areas and in integrated management. A second Pacific Region MEQ Indicators Workshop held in 2004 continued the regional and national initiative to determine operational objectives for monitoring the effectiveness of EBM in the pilot proposed Pacific North Coast Integrated Management Area (PNCIMA). This workshop considered both high level, nationally-defined conceptual ecosystem objectives and a "bottom-up" perspective in an effort to allow better focusing on those human activities actually impacting on the environment. The development of MEQ objectives and indicators was determined by looking at key issues or "stressors" on ecosystem components in three areas: a potential Coastal Management Area (Quatsino Inlet CMA), the deep-water trawled areas of Queen Charlotte Sound, and in the overall proposed PNCIMA, i.e., a potential Large Ocean Management Area. This "bottom-up" approach utilised estimates of tangible threats to marine ecosystem health in the assessment of potential MEQ objectives and indicators.

Introduction

When the *Oceans Act* was proclaimed in 1997, there was little concept in Canada as to what Integrated Management (IM) actually meant in practical terms. This was not unlike the situation in other counties. Much of the dialogue had been at a higher policy level with little linkage to implementation. Since then, there has been much discussion on implementation both in Canada and elsewhere, with various approaches starting to emerge (e.g. Garcia and Staples, 2000a; Pajak, 2000; Sainsbury and Surmaila, 2003).

IM is one of three key principles of Canada's *Oceans Act.* As part of Canada's Oceans Strategy, the "Policy and Operational Framework for the Integrated Management of Estuarine, Coastal, and Marine Environments in Canada" (Anon. 2002a) describes how ecosystem objectives (EOs) will be established as a part of an Ecosystem-based Management (EBM) process at the Large Ocean Management Area (LOMA) and Coastal Management Area (CMA) scales. EOs, which should be consistent within Fisheries and Oceans Canada (DFO)-defined ecoregions, are set at the LOMA scale, and Marine Environmental Quality (MEQ) objectives and indicators are developed at the CMA scale to provide the scientific evaluation that EBM is being achieved. Monitoring of MEQ indicators should give warning of potential significant ecosystem impact occurring.
In March 2001, a national workshop was held to identify broad conceptual objectives that could be used in IM under the overarching objectives of conservation of species and habitat. A national framework for identifying ecosystem objectives was developed whereby a set of high level conceptual objectives would be defined with increasing detail and specificity down to operational MEQ objectives in a process termed "unpacking" (Jamieson et al. 2001).

In the Pacific Region, the Central Coast was initially identified as one of two Canadian pilot areas to investigate Integrated Management (IM) implementation, and as part of this initiative, a MEQ

workshop was held in June, 2002 (Jamieson et al. 2003). It attempted to apply the national framework to the potential British Columbia Central Coast LOMA, and within it, the Quatsino Sound CMA, as an initial evaluation of the process to determine a potential suite of MEQ objectives and indicators. The Central Coast is now being considered as part of a larger Pacific North Coast Integrated Management Area (PNCIMA), which has now become the Pacific coast pilot IM area. The output of the 2002 workshop was that through a solely top-down process, there are potentially thousands of potential MEQ objectives, and so ones that might be proposed for selection are to a large extent determined by the mix of discipline expertise that participants brought to the unpacking process. In general, it was felt that such a process was thus likely to be biased, since appropriate expert participation is difficult to achieve A top-down approach alone was thus considered not particularly useful, since an inadequate 'suite' of objectives would likely be proposed (Jamieson et al. 2003). There have also been continued attempts at both the national and regional levels to refine the definition of an ecosystem approach to IM (e.g. O'Boyle and Keizer 2003; O'Boyle and Jamieson submitted), and in February, 2004, there was a national workshop that suggested guidelines (DFO 2004) for the determination of MEQ objectives from national conceptual EOs.

A second Pacific MEQ Indicators workshop was held in March, 2004 as a continuation of the Pacific Region pilot initiative (Jamieson and McCorquodale 2004). This workshop differed in that while keeping in mind the high level conceptual ecosystem objectives, it also considered a "bottom-up" perspective. MEQ objectives and indicators were determined by looking at key issues or "stressors" on ecosystem components in three areas: the potential Quatsino Inlet CMA, the deep-water trawled areas of Queen Charlotte Sound, and in the overall proposed PNCIMA, which is a potential LOMA. This "bottom-up" approach utilised an estimation of tangible threats to marine ecosystem health for developing MEQ objectives and indicators. A similar approach has previously been used to assess and monitor marine ecosystem health, but on a much smaller scale (Mark et al. 2003). The following provides a summary of workshop presentations, discussions and conclusions.

National Approach

DFO's National Policy Committee in June of 2000 proposed a framework for setting ecosystem objectives that included developing a suite of objectives, indicators and reference points for the maintenance of biodiversity, productivity and water quality within coastal ecosystems of concern. Subsequently, there has been considerable work – but as yet no overall consensus – to define and determine operational objectives for the environmental dimension. Conceptual objectives for the social and cultural, economic and institutional dimensions have yet to be determined. Finalised conceptual objectives for the environmental dimension are:

- To conserve enough components (ecosystems, species, populations, etc.) so as to maintain the natural resilience of the ecosystem;
- To conserve each component of the ecosystem so that it can play its historical role in the foodweb (i.e., not cause any component of the ecosystem to be altered to such an extent that it ceases to play its identified historical role in a higher order component); and
- To conserve the physical and chemical properties of the ecosystem.

Recognising that management goals need to be considered at both the conceptual and operational level (Garcia & Staples, 2000b, Sainsbury and Sumaila, 2003), conceptual objectives (Jamieson et al., 2001; Sainsbury and Sumaila, 2003) are stated in broad, general terms intended to be understandable by a general audience. In addition, they tend to be valid for long time periods (O'Boyle, 1993). Policy statements by a government or organization, for instance, can be

considered conceptual objectives. Given that they are broad statements, there is, however, a danger that they will be interpreted differently by different people. In addition, they lack the specificity to be operational, i.e. result in a particular management action based upon the degree of divergence of a measurable indicator from a pre-determined reference point.

Operational objectives are the strategies by which the conceptual objectives are actually implemented. Jamieson et al. (2001) considered that an operational objective consisted of a verb (e.g., maintain), a specific measurable indicator (e.g., biomass), and a reference point (e.g., 50,000 t), thus allowing an action statement for management (e.g., maintain biomass of a given forage species greater than 50,000 t biomass). This extends current definitions of operational objectives in the literature (Anon. 2003; Sainsbury and Sumaila, 2003). It should be pointed out here that the *Oceans Act* also refers to Marine Environmental Quality (MEQ) objectives. These are incorporated in IM plans to facilitate implementation of an ecosystem approach. MEQ objectives in are functionally synonymous with the definition of operational objectives stated above. In this paper, we will use conceptual and operational terms as they are more in line with international-used terms.

Jamieson et al. (2001) proposed that each objectives into operational objectives occurs through a process termed 'unpacking' (Figure 1). Unpacking involves considering each conceptual objective associated with a component / sub-component and determining whether or not a final operational objective can be stated. In other words, can a measurable indicator and reference point (see Appendix 1 for definitions) be associated with that sub-objective? This requires an understanding of what knowledge and information is available at the different points in the unpacking process upon which indicators and reference points can be based. If this information is available, then the unpacking process stops and the final operational objective associated with that conceptual objective is defined. Otherwise, a further unpacking occurs which is again tested for it being a final operational objective. The unpacking stops when all conceptual objectives have been addressed. Note that some authors (Anon. 2002b) use the term 'Strategy' to refer to a sub-objective, without specifying whether or not this is conceptual or operational.

This process allows many levels of sub-objectives to be sequentially considered, all emanating from an initial, conceptual objective. It is important to note that a hierarchy of components and objectives is not per se being developed, except at the highest level (e.g. the starting point to the unpacking). Rather, different conceptual objectives might be unpacked to different extents, but the level at which an associated operational objective is defined does not affect its relevance or importance relative to other operational objectives.

A national workshop (DFO 2004) held in February 2004 provided interpretation guidelines for terms used by Jamieson et al. (2001) in determining the utility of conceptual objectives at an operational level. Elements considered included were mean generation time, bounds of natural variability, primary productivity, historic role in the food web, resilience, habitat, communities, species and populations.

Pacific Regional Approach

A second Pacific Region MEQ Indicators Workshop was held in March, 2004, as a continuation of the regional initiative to determine operational objectives for monitoring the success of ecosystem-based management in the pilot Pacific North Coast Integrated Management Area (PNCIMA). This workshop differed from the first (Jamieson et al. 2003) in that while keeping in mind the high level, nationally-defined conceptual ecosystem objectives, it considered a “bottom-up” perspective in an effort to allow better focusing on those human activities actually impacting on the environment.

Objectives were:

1. To inform participants of the work to date on and current status of:
    a. The national Marine Environmental Quality (MEQ) Framework;
    b. Related federal work to develop marine indicators at large (LOMA) and local (CMA) scales; and
    c. Related British Columbia provincial work to develop marine indicators.

2. At the CMA and LOMA scales, to:
    a. Recommend a draft candidate 'suite' of MEQ indicators that would provide an assessment of the overall health and impacts of stressors of relevant marine ecosystems; and
    b. Evaluate the utility of using a "bottom-up process" to develop such a candidate suite of MEQ indicators.

3. To suggest appropriate "next steps" for parties involved in identifying MEQ indicators at the CMA and LOMA scales for the Pacific Region.

The development of MEQ objectives and indicators was determined by looking at key issues or "stressors" on ecosystem components in three areas: the potential Quatsino Sound CMA, the deep-water trawled areas of Queen Charlotte Sound, and in the overall proposed PNCIMA, which is a potential LOMA. This "bottom-up" approach utilised estimates of tangible threats to marine ecosystem health in the assessment of potential MEQ objectives and indicators. Overall, this approach had merit (Figure 2) and resulted in a more tractable suite of potential indicators than resulted from the solely top-down approach investigated at the earlier workshop (Jamieson et al. 2003). Potential indicators are not listed here, though, as they are both stressor and site specific and while they will be considered in detail at later planned follow-up workshops, at this time they are not considered to constitute a complete set of appropriate indicators. At the workshop, suggestions were provided as to how to effectively utilize this approach, and a key concern raised by participants was that progress to date was being impeded due to the perceived low priority given to this issue by senior managers. Participants raised concern about the ability of the department to move forward on these initiatives without a significant increase in the allocation of resources to ecosystem-based management initiatives. Workshop summary comments for suggested next steps towards developing MEQ indicators and practising Integrated Management thus related to DFO's future role in developing MEQ indicators, the potential for the Federal/Provincial Oceans-related Memorandum of Understanding on the implementation of Canada's Oceans Strategy to advance this issue, and the importance of integrating effective involvement of all relevant regional DFO Branches and personnel in future MEQ initiatives.

It was also suggested that 1) a broader group of interests (including people from within and beyond DFO) could be brought together to work with a few indicators and stressors in a focused and real situation. Representatives within this group may have differing mandates, but should share ideas about their objectives in an effort to establish a common approach; and 2) that higher level agency managers or those not involved to date with MEQ may have problems understanding the MEQ concept and its application. Case studies, or even a simulation, might be used to help them better comprehend the potential values and results that could be achieved using MEQ objectives and indicators in a "real-life" Integrated Management situation.

The workshop clearly met Objectives 1 and 3. There was much discussion around Objective 2, but the expectation at this second workshop was not to develop a final unified list of candidate MEQ indicators. Rather, it was to evaluate the potential of a bottom-up process in the identification of an acceptable mix of appropriate MEQ indicators to monitor. Progress was made in the sense that potential MEQ indicators were identified by each group, and that it was generally agreed that a bottom-up process should become a significant evaluation of any final determination of MEQ indicators. Major challenges relate to addressing scale issues in terms of how EOs in CMAs and LOMAs relate to each other, if at all, and in determining how completely relevant higher level ecological objectives can be addressed by primarily considering indicators relevant for a few known impacts.

References

Anon. 2002a. Canada's Ocean Strategy. Fisheries and Oceans Canada. Oceans Directorate, Ottawa, Ontario. 30pp.

Anon. 2002b. Groundfish Management Plan. Scotia-Fundy Fisheries Maritimes Region. April 1, 2002 - March 31, 2007. DFO Management Plan.

Anon., 2003. Fisheries Management. The Ecosystem Approach to Fisheries. FAO Technical Guidelines for Responsible Fisheries. 4 (Suppl.2). 112pp.

DFO 2004. Habitat Status Report on Ecosystem Objectives. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/001: 11 p. (http://www.dfo-mpo.gc.ca/csas/Csas/status/2004/HSR 2004_001_E.pdf)

Jamieson, G.S., and B. McCorquodale. 2004. Proceedings of the Central Coast Marine Environmental Quality Indicators Workshop, March 10-12, 2004, Parksville, BC. CSAS Proc. Ser. 2004/025: ? pp.

Jamieson, G, R. O'Boyle, J. Arbour, D. Cobb, S. Courtenay, R. Gregory, C. Levings, J. Munro, I. Perry, and H. Vandermeulen. 2001b. Proceedings of the National Workshop on Objectives and Indicators For Ecosystem-based Management. Sidney, British Columbia, 27 February – 2 March 2001. CSAS Proc. Ser. 2001/09: 140 pp.

Jamieson, G, B. Bauer and H. Vandermeulen. 2003. Proceedings of the Central Coast Integrated Management Marine Environmental Quality Workshop, June 5-7, 2002, Parksville, BC. CSAS Proc. Ser. 2003/13: 86 pp.

Garcia, S.M. and D. Staples. 2000a. Sustainability Indicators in Marine Capture Fisheries: Introduction to the special issue. Mar. Freshwater Res. 51: 381-384.

Garcia, S. M. and D.J. Staples. 2000b. Sustainability Reference Systems and Indicators for Responsible Marine Capture Fisheries: a review of concepts and elements for a set of guidelines. Mar. Freshwater Res. 51: 385-426.

Mark, S., L. Provencher and J. Munro. 2003. Approach for the assessment and monitoring of marine ecosystem health with application to the *Mya-Macoma* community. Canadian Technical Report of Fisheries and Aquatic Sciences No. 2491.

O'Boyle, R. 1993. Fisheries Management Organizations: A study of uncertainty. P 423 - 436. *In* S. J. Smith, J. J. Hunt and D. Rivard [ed.]. Risk evaluation and biological reference points for fisheries management. Can. Spec. Publ. Fish. Aquat. Sci. 120.

O'Boyle, R. and P. Keizer. 2003. Proceedings of Three Workshops to Investigate the Unpacking Process in Support of Ecosystem-based Management. CSAS Proceedings 2003/004.

O'Boyle, R. and G.S. Jamieson. Observations on the Implementation of Ecosystem-based Management: Experiences on Canada's East and West Coasts. Submitted to Ocean and Coastal Management.

Pajak, P. 2000. Sustainability, Ecosystem Management, and Indicators: Thinking Globally and Acting Locally in the 21st Century. Fisheries. 25:16 - 30.

Sainsbury, K. and U. R. Sumaila. 2003. Incorporating Ecosystem Objectives into Management of Sustainable Marine Fisheries, Including 'Best Practice' Reference Points and Use of Marine Protected Areas. P. 343 - 361. In Sinclair, M. and G. Vladimarsson. [ed] Responsible Fisheries in the Marine Ecosystem. FAO & CABI Publishing. 426pp.

Conceptual Objectives		Operational Objective
Objective ↳Sub-objective ↳…	Maintain Productivity ↳Trophic Transfers ↳Forage Species ↳Target Escapement ↳(Maintain) Biomass	Consists of a Verb, Indicator and Reference Point Maintain Biomass of Forage Species > 50,000 t

Figure 1: The link between conceptual objectives and operational objectives. With the "maintenance of productivity" as an example conceptual objective, beginning to unpack it creates statements such as "maintaining trophic transfers and interactions within the foodweb". However, while this restatement is a more tractable concept than maintenance of productivity, it is still far from what managers can deal with practically. Therefore, the concept of 'trophic transfers' is further unpacked. This produces a more specific statement on the "maintenance of forage species", and then, in turn, "of target escapement" and of "biomass". A point is finally reached where some component of the ecosystem is associated with a particular measure or indicator, and at this point, the objective can be termed operational.

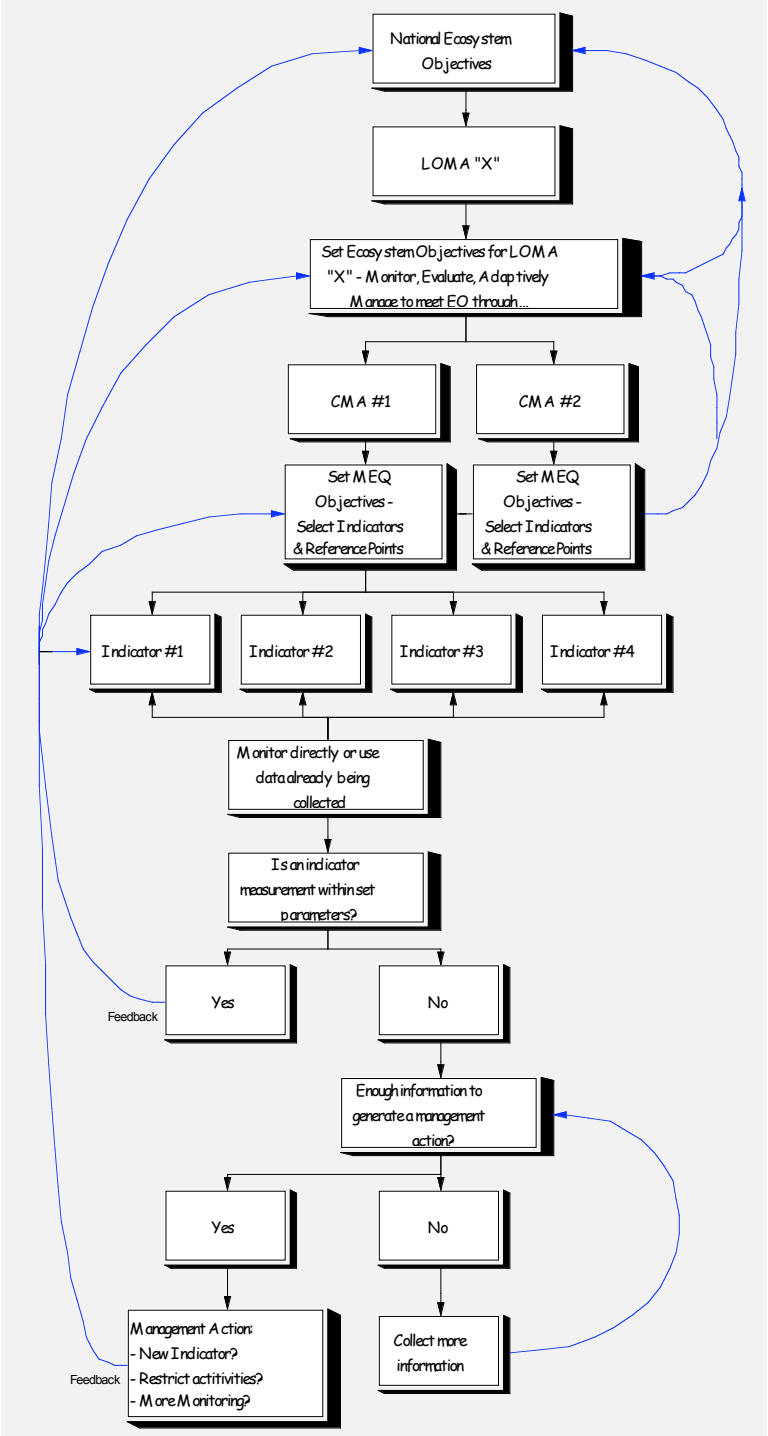

Figure 2: This proposed "flow chart and decision tree" for the development and adaptation of MEQ objectives and indicators at LOMA and CMA scales provides a schematic overview of a potential operational process.