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# FURTHER GUIDANCE ON THE FORMULATION, PRIORITIZATION, AND USE OF CONSERVATION OBJECTIVES IN AN ECOSYSTEM APPROACH TO INTEGRATED MANAGEMENT OF HUMAN ACTIVITIES IN AQUATIC ECOSYSTEMS


*Figure 1: Department of Fisheries and Oceans' (DFO) six administrative regions.*

**Context :**

*For over a decade DFO has been increasingly placing its policy and management decisions in the context of an ecosystem approach to management. Correspondingly, Science has been making ecosystem-centered research, assessment, and advice an increasingly central focus. Endorsements of ecosystem research as Science's highest priority by the Science Management Board and by the national Science Retreat in Montebello has accelerated this process.*

*Science has been developing components of an assessment and advisory framework for ecosystem-based advice, primarily in the context of the Large Ocean Management Area initiatives under the Ocean Action Plan. A key part of that advisory framework is the development of Conservation Objectives (COs) for use in integrated management planning. These Conservation Objectives are a major product of the Ecosystem Overview and Assessment Reports (EOAR), and the central science input to integrated management planning. Because of this central role, it is important that the properties and functioning of these Objectives is understood clearly and applied consistently, and the processes for developing the Conservation Objectives be clear and comprehensive.*

## SUMMARY

- Greater clarity is needed about the need for identification of Degraded Areas as part of the Ecosystem Overview and Assessment Report (EOAR) / Conservation Objectives (CO) processes, and a process for work in this area is proposed.

- The EOAR assessment framework and the development of Conservation Objectives are generally appropriate for coastal as well as offshore ecosystems, but there are many issues of applying the framework and processes on finer spatial scales that need to be addressed.

- The experience of using the Ecologically and Biologically Significant Areas (EBSA) and Ecologically and Biologically Significant Species (EBSS) criteria and guidelines in preparing the EOARs suggests that these documents are a useful starting point for identifying conservation priorities and are working reasonably well, although there is undoubtedly scope to improve all criteria and guidelines.

- The boundaries of the EBSAs in the EOARs should not be mis-interpreted as rigid and precisely determined boundaries on the ecological properties of the EBSAs. The lines on the maps are based on the best information available applied and interpreted *at the scale of the Large Oceans Management Areas (LOMAs)*, to support integrated planning and management at that scale.

- Past guidelines regarding prioritizing the Conservation Objectives are reasonable and should continue to be used, even if the lists of top priorities may be long. As experience is acquired in what management will do with the Conservation Objectives, there may be new insights into how to more effectively prioritize Conservation Objectives.

- The EOAR and Conservation Objective approach has been developed for marine ecosystems, but is a reasonable starting point for ecosystem approach to conservation and sustainable use of freshwater ecosystems as well.

- The Ecosystem Overviews and Assessments have been done on relatively large spatial scales, but many management questions and conservation issues may be most appropriately addressed at smaller scale (and sometimes larger ones), particularly in coastal areas. Some guidance is provided on how adapt scales of EOAR results and COs.

- All participants from management sectors concurred that Conservation Objectives have value in their work. Moreover, aspects of their work related to both conservation and planning for integrated and sustainable use would be more difficult to achieve without having explicit Conservation Objectives.

- Conservation Objectives for Pressures have been shown to be useful in actual management decision-making in a number of applications at both the levels of selection of strategies and tactics.

- Conservation Objectives for the State of specific structural and functional properties of ecosystems are meaningful and important to many stakeholders, including Environmental Non-Government Organizations (ENGOs), CNGOs (Conservation Non-Government Organizations), industries, and Aboriginal Peoples. Managers consider them an important part of science advice on Ecosystem Objectives, and examples of their use in management need to be developed more fully.

- Important progress has already been made in incrementally adding specific ecosystem considerations to existing management policies, strategies, and tactics, and the underlying science advice, primarily using Pressure-oriented Objectives. However, in addition to the Pressure-based assessments and advice an operational advisory framework requires that:

- indicators for the Conservation Objectives for States are identified;
- there are periodic audits of the status of the indicators relative to ecologically based benchmarks; and
- there are fora where all operational sectors must address how they are managing the pressures exerted by their sectors relative to discrepancies between the audited status of the ecosystem and the ecologically based benchmarks.

- Conservation Objectives used in policy and management require scientifically sound foundations, which the EOARs were designed to provide. A lesson confirmed by the EOAR process is that assembling the necessary science will not be easy, but is feasible

## BACKGROUND

Guidance has been given in past Science Advisory Reports (SARs) for the development and prioritization of Conservation Objectives. However this guidance was provided at a time when there was relatively little experience with their formulation and application. Since that guidance was provided, the Science work in support of the first five Large Ocean Management Areas has been completed to the point where candidate Conservation Objectives have been developed. In the process a number of additional questions arose about how to formulate and prioritize the Conservation Objectives, and significant experience was acquired about applying the guidance. In addition, a national retreat in November 2007, to revisit the "Dunsmuir framework" from 2001, further developed a number of conceptual, strategic, and operational issues associated with how the Department will implement the Ecosystem Approach and Integrated Management. Some of these developments had implications for the formulation and use of Conservation Objectives.

Following the recommendations and conclusions from the "Dunsmuir II" meeting, it was considered timely to review and augment the guidance on formulation and prioritization of Conservation Objectives, to apply the lessons learned in the LOMA initiatives and address some of the new questions which had arisen from that initiative and from Dunsmuir II. A meeting in January 2008, with participation from all Regions and all departmental Sectors reviewed experience in both the LOMA and Ecosystem Approach to fisheries, augmented the past guidance on Conservation Objectives in a number of ways reported in this SAR.

## FURTHER GUIDANCE IN VARIOUS ASPECTS OF DEVELOPING CONSERVATION OBJECTIVES

### Degraded Areas

1. Greater clarity is needed about the need for identification of Degraded Areas as part of the EOAR / Conservation Objectives (CO) processes, and the things that would be expected to happen if areas were included in a list of Degraded Areas. Science will ask all the DFO Management Sectors to specify what uses they would make of Science advice on Degraded Areas. It is expected that the question would be most relevant to Oceans and

Habitat Management sectors, and that these sectors would bring in information and perspectives from other federal departments and other levels of government.

2. If Science senior management concludes that the uses of science advice on Degraded Areas warrants the investment, there should be a workshop to develop criteria and guidelines for identification of Degraded Areas. This workshop would be organized similarly to the workshops on EBSA and EBSS criteria and guidelines, although in recognition of the many level of government involved in protecting coastal environmental quality the participation would be much broader, including greater participation by experts from other government departments, levels of government, and First Nations.

3. Background documents would feature the criteria and related science documents for Degraded Areas in the Great Lakes, and similar documents from IMO and MarPol sources, and from past work on standards for marine environmental quality done by expert groups of ICES and PICES.

## Coastal

4. The EOAR assessment framework and the processes in which the framework has been applied are generally appropriate for coastal as well as offshore ecosystems. There are sound biological reasons to have assessments consider both coastal and offshore areas together because many biological processes are linked, and there are no strong biological reasons to assess them separately.

5. The EBSA and EBSS/Community Properties (CP) criteria should apply to coastal as well as offshore ecosystems without any major amendments. The spatial patterns in data and ecological features may be finer in coastal than offshore, and the specific types and mix of Conservation Objectives resulting from applying the criteria may be different. However, the criteria and guidelines can work at both scales (and those in between).

6. In cases when management needs require ecosystem assessments at finer scales, including Coastal Management Areas (CMAs), the assessments should generally follow the EOAR framework, taking account of any differences in data availability and the broader range of human activities and pressures likely to need consideration at the CMA scale.

7. Within a LOMA-scale area, there may be a number of separate Coastal Management Areas, with Coastal Management Plans (CMPs) possibly being developed for each. When a CMP is desired a supporting EOAR at the CMA scale will usually be necessary. In such cases there can be economies of effort from grouping the CMAs into categories of areas with broadly similar ecologies and suites of pressures. Then a generic ecosystem assessment of the main ecological features, processes, and pressure interactions could be done for a category of CMA, followed by case-specific adaptations as needed.

8. Science and Oceans Management need to discuss the workload implications of the initiatives related to CMA assessments and other support for CMPs, and develop a strategy for dealing with the workload and science quality assurance needs.

## Past Advice

9. The experience of using the EBSA and EBSS/CP criteria and guidelines in preparing the EOARs suggests that these documents are a useful starting point for identifying conservation priorities. Although there is undoubtedly scope to improve all criteria and guidelines, they are working reasonably well, and refining the criteria is not considered a priority.

10. There has been much more experience with the EBSA criteria than the EBSS/CP criteria, and there is more confidence in the usefulness of the EBSA criteria (but this should not be interpreted as meaning that EBSS/CPs are considered to be less important or of lesser priority than EBSAs as conservation objectives).

    a. In practice, the real value of applying the criteria does not lie in the final lines drawn on maps of the LOMA (or area in which the ecosystem assessment is being conducted). Participants from both the ecological science and the management and policy sectors agreed that the real value is in the layering of information that is part of the process of applying the criteria. Different clients of the science advice need different parts of this information and use it in different ways. Therefore the layers of information used in applying the EBSA criteria are at least as important to include in the science advice as are the final maps of where the candidate EBSAs may be located.

    b. Because of the value of the information layering, the value of ensuring all DFO (and partner) data holdings are geo-referenced and readily accessible was confirmed. The participants noted that achieving full geo-referencing and accessibility of DFO data holdings will be neither cheap nor necessarily easy, but reconfirmed that the benefits are worth the costs. They also noted that there are advantages to approaching these tasks in a nationally coordinated way. A full strategy should be developed for addressing these needed for geo-referencing and making more readily available DFO's extensive data holdings.

    c. Some concerns have arisen that the boundaries of the EBSAs in the EOARs are being over-interpreted as rigid and precisely determined boundaries on the ecological properties intended to be captured in the EBSAs. This is a mis-interpretation of the boundaries. The lines on the maps are based on the best information available but the information is applied and interpreted at the scale of the LOMAs, to support integrated planning and management at that scale. At that scale it is unrealistic to expect every EBSA boundary will be determined with high precision. To the extent that a particular EBSA at the LOMA scale triggers planning or management follow-up, that follow-up process should be the place where boundaries are made hard on ecological grounds. However, the determination of the EBSA boundaries should continue to be based on science information complemented by traditional knowledge. The further clarification of ecologically-based boundaries should precede the planning and management discussions about user needs and management measures to keep risks to the significant features low.

11. No major flaws were encountered in using the EBSS/CP criteria and guidelines, but they have not been available for long enough to fully understand their strengths and weaknesses, if any.

    a. Of the EBSS/CP criteria and guidelines, the major challenges in applying those related to the species and community-based structural features of ecosystems were simply lack of data in many areas. This can only be addressed through building up information bases through research and partnerships.

    b. The major challenges in applying the criteria and guidelines related to trophodynamic roles of species and species groups were a lack of robust models of food web dynamics, and of information to parameterize such models. This means that it sometimes may not possible to even identify the species with dominant roles in the food web, and that it will rarely be possible to make more than very general predictions of the ecosystem consequences of perturbing the abundance of a particular species. Hence the species listed currently as EBSSs constitute the best advice possible with the information available; however, the advice is more uncertain than many other products of the EOAR / Conservation Objective process. The EBSS lists are generally considered to reflect the application of precaution, and with more research and modelling on food web structure and dynamics in these ecosystems, it is likely that the lists of species considered to meet the various trophodynamic criteria will be modified, and may be reduced.

    c. Notwithstanding the uncertainty of food web structure and dynamics there was strong agreement that including trophodynamic relationships is an important component of implementing an ecosystem approach to policy and management. It is stressed that there are important limits on the progress that can be expected on application of an ecosystem approach until there is better knowledge of food web relationships and more robust models for use in supporting ecosystem assessments and application of EBSS/CP criteria. Although the report of the DFO national ecosystem modelling working from October 2007 is not yet available, the reported conclusions and recommendations for action may contain useful guidance. Such work and the associated building of capacity in DFO Science, is considered a priority.

    d. Notwithstanding progress that may be made on 11c, there will always be substantial uncertainty about the status of aquatic ecosystems relative to Conservation Objectives based on trophodynamic relationships. Hence it will also be necessary to develop a defensible framework for including potentially large uncertainty about the status of these (and often other) Conservation Objectives in science advice and in management decision-making.

12. The criteria for Ecologically Significant Community Properties were identified in SAR 2006/041 as likely to be incomplete relative to all community properties that are important for maintaining ecosystem structure and function, and productivity and resilience. They are considered likely to be incomplete both because information to specify and test candidate criteria was incomplete, and because ecological theory to provide a basis for such criteria is also still evolving. All the points made about further science needed to apply the EBSS criteria effectively for trophodynamic roles of species also apply to criteria for Ecologically Significant Community Properties. However for community properties the

need for additional science support is even greater, both to have the information to apply the existing criteria, and possibly more importantly, to refine the existing criteria, determine if additional ones should be added, and if so what community-scale criteria should be added

13. It was noted that the total lists of candidate Conservation Objectives that came from application of the EBSA, EBSS/CP, and depleted species criteria and guidelines may be too long for management to address all at once. There was some discussion of the effectiveness of the guidelines provided in CSAS 2007/10 regarding prioritizing the Conservation Objectives. They are considered reasonable guidelines and should continue to be used, even if the lists of top priorities may be long. As experience is acquired in what management will do with the Conservation Objectives, there may be new insights into how to more effectively prioritize Conservation Objectives. More meetings at this time to refine or augment the principles and guidelines for setting priorities would be of limited value.

14. With regard to applying the criteria in data-poor areas, it was noted that all areas are data-poor compared to the ideal, although some areas are certainly more data poor than others. The use of Experiential and Traditional Ecological Knowledge (TEK) was considered a suitable complement to what data are available for any area, much as Delphic processes are a suitable complement for more structured analytical assessments. However, best science practices remain the full analyses and interpretation of information and data collected using suitable research designs, and to this end, it must be a priority to improve data archiving, metadata, and accessibility. The ability to conduct a Delphic process should not be used as an excuse not to conduct analyses of data that do exist or to fail to undertake feasible modelling. Moreover, the quality of TEK can be improved through the use of methods developed in the social sciences. In that context all sectors of DFO have a major stake in the work of the Centre of Expertise (COE) on Traditional Knowledge that is being developed by Oceans Sector.

15. The need for peer review of EOARs, and their publication in accessible formats was confirmed. Processes that extract inventories of EBSAs, EBSS/CPs, degraded areas, depleted species, and convert these inventories into prioritized Conservation Objectives need to have the features of SAGE-compliant peer review and provision of science advice to governments.

16. The full EOAR and Conservation Objective approach has been developed for marine ecosystems. However, there is a need for a comparable systematic framework for advancing an ecosystem approach to conservation and sustainable use of freshwater ecosystems as well. Although the various criteria and guidelines were not reviewed explicitly in the context of their applicability to freshwater ecosystems, meeting participants with backgrounds in freshwater systems saw much promise in the overall approach and its components. Some parts of the overall framework have already started to be applied successfully in freshwater ecosystems, and more exploration of the suitability of the entire framework for freshwater ecosystems was encouraged.

## Scaling Up and Scaling Down

17. The Ecosystem Overviews and Assessments have been done on relatively large spatial scales, but many management questions and conservation issues may be most

appropriately addressed at smaller (and sometimes larger ones), because of the scale of either the activity being managed or the ecosystem property being conserved. This requires scaling information and conclusions down (and sometimes up) from the scale of the EOAR to the scales of management and conservation. This need for scaling is expected to arise from time to time, regardless of the scale at which an integrated ecosystem assessment may have been done. Some guidance can be provided on how to conduct such scaling soundly.

a. When data or information about a particular area are available, the local information should generally be considered most relevant to supporting management and policy.

b. For areas offshore, ecosystem assessments generally require interpolation of information among sampling sites, and these sites are commonly selected using survey designs which make such interpolation scientifically legitimate. Stratification criteria that are useful for guiding the extent of extrapolation / interpolation of information collected at offshore sites are well known (common ones include similarity of sites by depth, substrate, and proximity in lat/long). Consequently, scaling assessments and specific types of information down (or up) is thought to present no special problems –one should just use the most appropriate local weighting of sites from which information is available.

c. However, there are some ecological features, such as some habitat structural features, that are distributed on small spatial scales in the offshore. If the management concern is focused on such features, the guidance on scaling down for the inshore (Paragraph 18) is relevant.

18. For inshore areas a case can be made that the entire coastline would meet the criteria for an EBSA, and thus be a priority for risk averse management and conservation measures. (Similar arguments can be made for shelf breaks, polynyas, edge leads and other features.) This means that in coastal (and some other) areas there will often be a need to scale down from assessments and information at one scale to finer scales. In principle interpolation of assessment conclusions and information from “similar” areas remains legitimate, but is more complex for two reasons. One is that ecological variation important to management often occurs on smaller spatial scales than in offshore areas. The other is that less is known about the stratification criteria appropriate for inshore areas. If science support for an ecosystem approach to management of human activities or conservation of ecosystem features in the inshore is a priority, then several activities are needed.

a. A great deal of information on ecological features and processes and human activities have been collected in coastal areas, although survey designs that are appropriately stratified in a LOMA scale rarely have been used. All sectors of DFO should collaborate to bring together the diverse data sources in coastal areas and assemble them into easily accessible and readily integrated geo-referenced databases.

b. To the extent the information sources are found to be patchy, it will be necessary to extrapolate information from “similar” sites to sites of management or conservation concern but for which local data are not available. Research is needed to determine the most meaningful stratification criteria on which “similarity” can be judged for different coastal areas. These may not be the same

for all types of data, but possibilities include amount and seasonality of freshwater inflow, human demographic characteristics of the coastal areas or watersheds, tidal and other physical oceanographic processes, etc.

c. Groups have been working on these issues in the Pacific and Maritime Regions, and their work may provide useful information for any national initiatives in this area. Several ICES Expert Groups have also been addressing these issues, and their work should be reviewed and integrated into DFO initiatives.

19. As familiarity with the Driver – Pressure – State – Impact – Response (DPSIR) framework grows, there is increasing support for using that framework as a default conceptual framework in which to work when developing, applying, and especially communicating about Conservation Objectives and management related to those Objectives. However, using DPSIR as a default framework is not to be interpreted as prescriptive, and alternative approaches can be used when considered useful. Rather the DPSIR framework should be considered as a starting point for these activities, and used adaptively for as long as it proves useful.

## The Role of Conservation Objectives

20. Although Objectives exist at many levels of specificity from the conceptual to the operational, this part of the SAR uses the term "Conservation Objective" as defined in the Jan 2007 SAR. That is, "the specificity in phrasing of a Conservation Objective should be sufficient that it should be possible to select appropriate indicator(s) and reference points with no additional unpacking".

21. All participants from management sectors concurred that Conservation Objectives have value in their work. Moreover, aspects of their work related to both conservation and planning for integrated and sustainable use would be more difficult to achieve without having explicit Conservation Objectives. Conservation Objectives provide potentially value and utility for management of human activities that impact freshwater as well as marine eco systems.

22. Conservation Objectives for Pressures (*sensu* paragraph 19 – for example, Fishing Mortality) have been shown to be useful in actual management decision-making in a number of applications at both the levels of selection of strategies and tactics; for example, in management of the impacts of fisheries on target and bycatch species.

23. Conservation Objectives for the State (*sensu* paragraph 19 – for example Spawning Biomass) of specific structural and functional properties of ecosystems are meaningful and important to many stakeholders, including ENGOs, CNGOs, industries, and Aboriginal Peoples. Managers consider them an important part of science advice on Ecosystem Objectives. However, it is necessary to document and bring forward clear illustrations of how Conservation Objectives for ecosystem properties are used in practice in the formulation of policy and in management and regulatory decision-making

24. The necessary science support for integrated management in an ecosystem context will require Conservation Objectives for both Pressure and State properties. As noted in Paragraphs 9-15, the EOARs should give priority to identifying the structural and functional parts of the ecosystem most essential to giving the ecosystem its characteristic

productivity, biodiversity, quality, integrity, and resilience, and the major pressures on those ecosystem parts due to both human activities and environmental drivers. These key structural and functional parts of the ecosystem, and the major pressures on those parts, are necessary starting points for setting the Conservation Objectives, although further analyses, interpretation and unpacking may be necessary from the work reported in the EOARs.

25. Generally a thorough EOAR process may identify many candidate Conservation Objectives. A prioritization process following the general guidelines in SAR 2007/10 is an important step in building the science foundations for an ecosystem approach to integrated (or sectoral) management. However, consistent with the importance of Conservation Objectives for both Pressures and States, a risk assessment intended to identify the combinations of human activities and key structural and functional ecosystem components which pose the highest risks of unsustainable impacts is a vital step and must occur early in the overall process. Building capacity and provision of tested tools for such risk assessments is a high priority for all DFO Sectors.

26. Important progress has already been made in incrementally adding specific ecosystem considerations to existing management policies, strategies, and tactics, and the science advice supporting those policies, strategies and tactics. These incremental additions have been primarily Pressure-oriented, and have been effective in bringing industries and partners along in accepting the need for management to take these ecosystem considerations into account. Scope exists for more progress to be made in this way.

27. The Conservation Objectives for ecosystem State attributes arising from the EOARs set the scope of the ecosystem components which the Pressure-oriented approaches must address. This may be through modulating a Pressure directly, as Fishing Mortality (Pressure) is reduced when Spawning Biomass (a State) is low, but may require that new Pressures become important aspects of management and regulation, as the ecosystem footprint of various human activities is considered more fully in management. Hence, in addition to the Pressure-based assessments and advice described in the preceding paragraph, an operational advisory framework requires that:

    a. indicators for the Conservation Objectives for States are identified;

    b. there are periodic audits of the status of the indicators relative to ecologically based benchmarks; and

    c. there are fora where all operational sectors must address how they are managing the pressures exerted by their sectors relative to discrepancies between the audited status of the ecosystem and the ecologically based benchmarks.

28. Current sector-based fora emphasizing Pressure-oriented approaches to policy and management have not proven consistently effective at resolving conflicts over responsibility for reducing aggregate or cumulative impacts of multiple user sectors, particularly on State-based Conservation Objectives but also sometimes on Pressure-oriented Conservation Objectives. Policy and management Sectors of DFO and their diverse partners must address the need for effective settings for integrated planning and management, for the benefits of the supporting science to be realised.

29. Conservation Objectives used in policy and management require scientifically sound foundations, which the EOARs were designed to provide. A lesson confirmed by the EOAR process is that assembling the necessary science will not be easy, but is feasible. Much progress can be expected from increased investment in science in support of an increased ecosystem approach to integrated management. It is necessary to increase the priority of the science being done to provide the basis for formulating Conservation Objectives.

30. Conservation Objectives are important components of implementing integrated management in an ecosystem context, but the other components of the overall approaches need further development as well. Science needs to work with all the other DFO Sectors to develop both conceptual frameworks and operational tools that facilitate and inform integrated planning and decision-making. Priority operational tools include analytical approaches and methods for the evaluation of strategies, tactics, and tools for achieving multiple Objectives, and that allow multiple agents/sectors/managers to simultaneously consider the effects of their management actions on achievement of the full suite of Conservation Objectives. It will also be necessary to plan for how Science will support the integrated management planning dialogue, when the governance process requires timely feedback on the ecological (and social and economic) consequences of new options developed in the governance consultations.

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## FOR MORE INFORMATION

Contact: Jake Rice
National Senior Ecosystem Science Advisor
Ecosystem Science Directorate
Fisheries and Oceans Canada
200 Kent Street
Ottawa, Ontario K1A 0E6

Tel: 613) 990-0288
Fax: (613) 954-0807
E-Mail: Jake.Rice@dfo-mpo.gc.ca

This report is available from the:

Canadian Science Advisory Secretariat
National Capital Region
Fisheries and Oceans Canada
200 Kent Street
Ottawa, ON K1A OE6

Telephone: (613) 990-0293
Fax: (613) 990-2471
E-Mail: CSAS@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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