Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

C S A S | ***S C C S***

Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Proceedings Series 2008/004 | **Compte rendu 2008/004**

Proceedings of the Workshop on a Comparison of Australian and DFO Maritimes Approaches to Ecosystem Based Management

3 – 5 October 2006

St. Andrews Biological Station
St. Andrews, New Brunswick

R. Stephenson[1] and T. Smith[2]
Meeting Co-chairs

[1]St. Andrews Biological Station
Department of Fisheries and Oceans
531 Brandy Cove Road
St. Andrews, NB E5B 2L9
Canada

[2]Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Castray Esplanade, Hobart TAS 7000
Australia

May 2008

Compte rendu d'un atelier de comparaison entre l'approche australienne et celle de la Région des Maritimes du MPO dans la gestion écosystémique

Du 3 au 5 octobre 2006

Station biologique de St. Andrews
St. Andrews (Nouveau-Brunswick)

R. Stephenson[1] et T. Smith[2]
Coprésidents de la rencontre

[1]Station biologique de St. Andrews
Ministère des Pêches et des Océans
531 Brandy Cove Road
St. Andrews (N.-B.) E5B 2L9
Canada

[2]Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Castray Esplanade, Hobart TAS 7000
Australia

mai 2008

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses, or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

This workshop was not carried out as a formal Department of Fisheries and Oceans (DFO) Science Advisory process; however, it is being documented in the Canadian Science Advisory Secretariat (CSAS) Proceedings series as it presents some topics of interest related to the advisory process.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

Le présent atelier n'a pas été tenu dans le cadre officiel du processus des avis scientifiques du ministère des Pêches et des Océans (MPO). Celui-ci est toutefois documenté dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS), car il couvre certains sujets en lien avec le processus des avis.

Proceedings of the Workshop on a Comparison of Australian and DFO Maritimes Approaches to Ecosystem Based Management

3 – 5 October 2006

St. Andrews Biological Station
St. Andrews, New Brunswick

R. Stephenson[1] and T. Smith[2]
Meeting Co-chairs

[1]St. Andrews Biological Station
Department of Fisheries and Oceans
531 Brandy Cove Road
St. Andrews, NB E5B 2L9
Canada

[2]Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Castray Esplanade, Hobart TAS 7000
Australia

May 2008

Compte rendu d'un atelier de comparaison entre l'approche australienne et celle de la Région des Maritimes du MPO dans la gestion écosystémique

Du 3 au 5 octobre 2006

Station biologique de St. Andrews
St. Andrews (Nouveau-Brunswick)

R. Stephenson[1] et T. Smith[2]
Coprésidents de la rencontre

[1]Station biologique de St. Andrews
Ministère des Pêches et des Océans
531 Brandy Cove Road
St. Andrews (N.-B.) E5B 2L9
Canada

[2]Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Castray Esplanade, Hobart TAS 7000
Australia

mai 2008

ISSN 1701-1272 (Printed / Imprimé)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas/

CSAS@DFO-MPO.GC.CA

Printed on recycled paper.
Imprimé sur papier recyclé.

Correct citation for this publication:
On doit citer cette publication comme suit :

DFO. 2008. Proceedings of the Workshop on a Comparison of Australian and DFO Maritimes Approaches to Ecosystem Based Management; 3 – 5 October 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2008/004.

TABLE OF CONTENTS

SUMMARY

Representatives from the Maritimes Region's Science and Fisheries and Aquaculture Management (FAM) branches of the Department of Fisheries and Oceans (DFO), the Australian Fisheries Management Authority (AFMA), and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) met in St. Andrews, New Brunswick, in October 2006 to compare scientific research, approaches, and the state of tools for the application of science to support implementation of Ecosystem Based Fisheries Management (EBFM) within the broader approach to Ecosystem Based Management (EBM). Presentations on the policy context, current approaches and experiences with a variety of tools led to a comparison and an evaluation of the state of progress on EBFM in the two countries. The meeting concluded that there are similarities in policy context and drivers, as well as in the challenges to implementation of EBM in the two countries, but that "best practise" has not yet been established. In addition, there is an urgent need for case studies in the application of EBM in both Australia and in Canada. The structured approach of linking issues, strategies, and tools for management activities being used in the Maritimes Region was considered a practical and useful framework. Australian experience with the application of Ecological Risk Assessment (ERA), Management Strategy Evaluation (MSE), and bio-economic modelling was very instructive. There is potential for further development and collaboration in the following areas:

- Further development and comparison of methods, case studies, and experiences towards development of "best practise" for EBM.
- Continued evolution of ERA, and possible application to a Maritimes Region case study.
- Benthic habitat classification sampling and methods.
- Ecosystem comparisons and the role of ecosystem models.
- Communication of EBM concepts (and benefits) to stakeholders.

SOMMAIRE

Des représentants des Sciences et de la Gestion des pêches et de l'aquaculture (GPA) de la Région des Maritimes du MPO, de la *Australian Fisheries Management Authority (AFMA)* et de la *Commonwealth Scientific and Industrial Research Organisation (CSIRO)* se sont réunis à St. Andrews (Nouveau Brunswick) en octobre 2006 pour comparer leurs travaux de recherche scientifique, leurs approches et leurs outils dans l'appui scientifique à la mise en œuvre de la gestion de l'écosystème en général et plus particulièrement de la gestion écosystémique des pêches (GEP). Les exposés sur le contexte stratégique, sur les approches actuelles et sur les expériences d'utilisation de divers outils ont mené a une comparaison et à une évaluation de l'état d'avancement de la GEP dans les deux pays. On en est arrivé à la conclusion qu'il y avait des similitudes de part et d'autre dans le contexte stratégique et les déterminants, ainsi que dans les défis posés par la mise en œuvre de la GEP, mais que des pratiques exemplaires n'ont pas encore été établies dans ce domaine. De plus, il y a un besoin pressant de réaliser une étude de cas sur l'application de la GEP en Australie aussi bien qu'au Canada. L'approche structurée utilisée dans la Région des Maritimes, qui consiste à faire le lien entre les enjeux, les stratégies et les outils de gestion, a été jugée utile et pratique. Par ailleurs, l'expérience australienne en matière d'évaluation du risque écologique, d'évaluation de la stratégie de gestion et de modélisation s'est révélée fort instructive. Il existe un potentiel d'approfondissement et de collaboration dans les domaines suivants :

- Examen plus approfondi et comparaison des méthodes, études de cas et expériences en vue de l'établissement de pratiques exemplaires en matière de gestion écosystémique des pêches.
- Évolution continue de l'évaluation du risque écologique et possibilité d'appliquer cette dernière à une étude de cas dans la Région des Maritimes.
- Échantillonnage et méthodes pour la classification de l'habitat benthique.
- Comparaisons des écosystèmes et rôle des modèles écosystémiques.
- Communication des notions de gestion écosystémique (et de ses avantages) aux parties concernées.

INTRODUCTION

There has been considerable evolution in the conceptual development of Ecosystem Based Management (EBM) and related approaches over the past two decades arising from the United Nations (UN) Conference on the Law of the Sea, UN Conferences on Environment and Development, the Convention on Biological Diversity, and other international agreements. There is emerging international consensus on the need for evolution of management to include:

- a more holistic approach;
- recognition that management must consider the full set of ecological, social, and economic consequences of activities;
- a shift in focus of management from sustainability of target species and resources to wider focus on ecosystems and impacts of activities on them; and
- desire for "precautionary" decision-making and protection of ecological dependencies.

In the past five years, there has been rapid evolution of methodologies and attempts to apply EBM approaches. Both Australia and Canada have been trying to implement Ecosystem Based Fisheries Management (or an Ecosystem Approach to Fisheries), while at the same time there has been evolution of the ecosystem based approach to management more generally. It was considered timely to compare scientific research and approaches for the application of science to support implementation of EBFM. A small group, representing science and management, met to compare approaches and to provide guidance on best practice and future directions. This represented a significant step in the collaboration on EBFM that extends back almost a decade.

Meeting co-chairs, Rob Stephenson and Tony Smith, welcomed participants (Appendix 1) and reiterated the formal invitation (Appendix 2). The Agenda (Appendix 3) and the Terms of Reference (Appendix 4) for the meeting included the following objectives:

- discuss experiences in Australia and the Maritimes on the science in support of EBM, particularly as they apply to fisheries;
- compare and contrast these implementations from a technical perspective; and
- consider the features of the scientific framework required to guide EBFM.

Funding for this workshop was provided by DFO (International Governance Initiative and Maritimes Region), CSIRO (Marine and Atmospheric Research), and the AFMA.

POLICY CONTEXT

The workshop commenced with a session on EBM policy developments in Canada and Australia, and how this has influenced fisheries management in each country.

Presentation Highlights

Canadian (Maritimes Region) Ecosystem Approach to Fisheries: Management Perspective.
Presented by Les Burke.

Fisheries management plans are being expanded to address issues related to the bycatch of commercial, non-commercial, and especially protected species, in order to preserve biodiversity and to mitigate the impacts on benthic habitats. The expanded suite of strategies and management measures require expanded monitoring and measurement capabilities. An ecosystem approach also requires consideration of the cumulative effects of fishing on an

exploited area, presenting a number of governance challenges to the current single species management system. Operational multispecies or area-based governance mechanisms will be required in order to move forward in defining cumulative effects. These would require a significant and likely controversial change for stakeholders. Currently, a roundtable approach is the mechanism being used in the Maritimes Region to allow industry input into broader EBM processes, but this mechanism is not set up to address cumulative effects.

The challenges associated with implementation of an ecosystem approach are significant and include the need to fill knowledge gaps, to develop new strategies, and to increase monitoring and enforcement. The costs of increasing management scope will stress departmental budgets and could seriously undermine the viability of the fishing industry over the short-term at least. A systematic approach (gap analysis or risk analysis) is required that can identify the most important impacts in order to focus limited resources on measures that address or mitigate these impacts and keep the cost of management and compliance affordable.

Policy Drivers for EBFM in Australia - Fishery, Environmental, and Regional Marine Planning.
Presented by Andy Bodsworth.

The application of EBFM in Australian fisheries under Commonwealth (Federal) jurisdiction is strongly supported by legislative and policy instruments. The current approach includes fisheries management strategies and broader oceans management strategies against agreed Ecologically Sustainable Development (ESD) objectives. These strategies are not always effectively integrated across agencies and jurisdictions. Most recently, a Ministerial Direction to the AFMA has sharply focused efforts to deliver strong EBFM outcomes in a cost effective way. The focus of this Direction was in 3 areas – development of a Harvest Strategy Policy to cease overfishing and recover overfished stocks, development of strategies to reduce bycatch, and a strong focus on developing spatial management strategies. The fishery management focus is supported by environmental legislation (the Environment Protection and Biodiversity Conservation Act 1999) that requires fisheries to be assessed against ESD outcomes in an on-going cycle of 3 to 5 years.

Discussion

The conservation goals within EBM are very similar for Australia and DFO Maritimes Region. For both places, there has been a change in focus from concentrating on the productivity of fish stocks to inclusion of biodiversity and habitat considerations. For example, both places are undertaking efforts to reduce bycatch of non-target species and reduce the impact of fisheries and other human uses on habitat and bottom communities. The challenges faced in proceeding with these new objectives are also similar. For example, implementation within a larger multiple use oceans context is likely to be more challenging than working strictly within a fisheries context.

A key difference between the two countries is the requirement in Australia but not in Canada to conduct environmental impact assessments for all fisheries with an export component. This has required the evaluation of harvest plans to identify risks in terms of target species, bycatch species, threatened and endangered species, habitat, and communities. A triage is used to identify low, medium, and high level risks with increasing amounts of information required as one progresses through the three levels.

With respect to habitat impacts, both places seem to be focussing on area-based approaches (e.g., Marine Protected Areas (MPAs) and fishery closures), but there is a need to link these to the management objectives.

The responsibility for ecologically sustainable development in Australia is shared across at least four departments or agencies. AFMA is solely responsible for managing fisheries, but other aspects of ocean management are administered by the Department of Environment, the National Oceans Office, and the Department of Agriculture, Forestry, and Fisheries. Although efforts are made to coordinate across agencies, disagreements about management are not infrequent. In the Maritimes, DFO is responsible for leading implementation of EBM in the oceans. However, there are still administrative issues within the department. For example, the Fisheries and Aquaculture Management Branch has been working towards implementation of EBFM while the Oceans and Habitat Management Branch has been working to facilitate cross-sector EBM. In both places, there are varying degrees of understanding and acceptance of EBFM and EBM.

Canada and Australia differ in their approaches to funding the necessary work. Australia has initiated a cost-recovery program with industry funding assessment research (80%) and fisheries management (100%), while the government funds research determined to be for the greater good. Canada does not have a national cost-recovery program, but some initiatives in the Maritimes Region had been funded through joint project agreements. However, a recent court case has put these kinds of agreements in jeopardy.

APPROACHES TO EBM FOR FISHERIES

This session described approaches being pursued by DFO Science in the Maritimes Region and CSIRO to make EBM operational, including:

- strategies, indicators, reference points, tactical management measures, and decision or guide rules; and
- process, consultation, and stakeholder engagement.

Presentation Highlights

An Ecosystem Approach to Management: Chronology of Lessons and Experiences in DFO Maritimes Region since Proclamation of Canada's Ocean Act in 1997.
Presented by Bob O'Boyle.

Since proclamation of the Oceans Act in 1997, Canada has learned many lessons on the implementation of EBM. On Canada's east coast, the Eastern Scotian Shelf Integrated Management (ESSIM) pilot was initiated in 1998 to test implementation concepts through the broader multi-stakeholder integrated management approach. The pilot initially focused on governance issues and, thereafter, started to explore the development of objectives with associated indicators and reference points. Another Maritimes regional initiative focused on application of an ecosystem approach within the fisheries sector specifically. Since 2002, a series of smaller projects have aimed at incorporating ecosystem considerations into regional fisheries management plans. While the 2 initiatives have similar roots, they have followed different paths, along which much on implementation has been learned. A comparison of these experiences is both instructive and informative to longer term Maritimes regional ecosystem management planning. This working paper outlined a chronology of activities in both initiatives to illustrate how each has evolved and is related. Separate, more detailed, working papers are being prepared on the 2 initiatives.

Eastern Scotian Shelf Integrated Management (ESSIM) Initiative.
Presented by Tana Worcester.

A national framework for the implementation of Integrated Management in Canada has been developed by DFO. The framework consists of a) defining a large ocean management area (LOMA) based on ecological and socio-economic considerations; b) gathering information on the ecosystem and the human system that is dependant on it; and c) setting ecosystem and socio-economic objectives for the area. DFO has identified 5 priority LOMAs; 1 of which is the ESSIM area. While this area is intended to include both inshore and coastal environments, the focus of ESSIM has been offshore (beyond 12 nm). Ecological information has been compiled in an Ecological Overview of the Scotian Shelf, which focused on a description of ecosystem components, and an Ecosystem Assessment describing the relationship between components. From this body of information, ecologically and biological significant areas, ecologically significant species and properties, degraded areas, and depleted species (species at risk) are to be identified. Following development of a national set of conservation objectives, a regional list of ecosystem elements and objectives was established. These were informed by internal and external working groups and presented in a Draft Eastern Scotian Shelf Integrated Ocean Management Plan (2005). A list of governance and socio-economic objectives were also developed, though without national guidance. The long-term goal is to develop indicators and reference points for each objective, as well as performance indicators, which would be reported in a consistent manner. In an effort to move in this direction, a series of strategies and action plans are being developed, which include research priorities, expected outcomes, and proposed timelines.

Science in Support of Ecosystem Based Fisheries Management.
Presented by Stratis Gavaris.

Fisheries management planning can be thought of as a hierarchical process that translates objectives into strategies (“what” will be done) and specifies tactical management measures to implement the strategies (“how” it will be done). Strategies are succinct statements of “what” will be done that include an indicator and a reference point.

A critical property of an indicator is that it responds to changing levels of the tactical management measure. The indicator reflects a pressure induced by an activity that is regulated by the management measure. Another critical property of the indicator is that the system responds to changing reference point levels for the indicator. Suitable reference point levels are selected to achieve the desired system response.

EBFM makes two simple but important changes. The first change is that EBFM expands the scope of conservation considerations beyond just the productivity of harvested resources to include additional consideration of biodiversity and habitat. A suite of strategies for EBFM is introduced. The aim was to make this list of strategies parsimonious, keeping it simple and manageable, while being comprehensive. This list may be revised as we gain experience. The suite of strategies embraces emerging ecosystem concerns, but puts them in the proper context using a comprehensive framework that recognizes and keeps important “conventional” fisheries management considerations. The second change introduced by EBM is to consider cumulative effects across activities in an area. The conservation strategies and the managed activities define the two fundamental dimensions of EBM.

Science supports two types of fisheries management decisions. Decisions on the “level” of a tactical management measure are about regulating the impact of the fishery on the ecosystem and affect the state of the indicator. Decisions on a suitable reference to signal when an

unacceptable condition results from a choice on the level of the management measure are about recognizing how ecosystem dynamics influence the way fishing should be regulated. Tools used by science to support such decisions for each of the strategies were reviewed. Several gaps in tools were identified. As well, fishery monitoring gaps for discards and for location of fishing activity were identified as being critical for making ecosystem based fisheries management operational.

Implementation of EBFM by the Australian Fisheries Management Authority - Progress to Date.
Presented by Tim Smith.

Australia has progressed in the implementation of EBFM since early 2001. This implementation is being driven by the recognition of the broader impacts of fishing on the marine environment, as well as legislative requirements for fisheries ecologically ESDs in both Australia's fisheries and environmental Acts. Aspects of EBFM were underway in AFMA prior to this time, although its implementation was ad hoc and inconsistent across fisheries. While Australia has made good progress in implementing many elements of an ecosystem approach to fisheries management, it is in early 2007 that the integration of all the relevant elements of an EBFM approach will take place for AFMA's fisheries.

The main elements of AFMA's current approach to EBFM are:

1. Information and data collection to support fishery assessments;
2. Ecological and stock assessments to prioritise and inform management;
3. Management actions to reduce ecosystem impacts to an acceptable level; and
4. Education and capacity building to bring industry along and inform the public.

In particular, the ERAs will guide fishery level priorities for research, data collection, and management across all components of the ecosystem. These assessments, along with other key drivers for EBFM, are being coordinated into management via the ecological risk management framework. This framework provides a consistent process for fisheries in responding to the management drivers, ensuring all fisheries are progressing with EBFM implementation. AFMA is at the stage of developing management responses to these drivers, focussing on determining what the acceptable level of risk or impact is and mitigating the impacts to these levels.

Overall, implementing EBFM is changing the way AFMA manages fisheries. AFMA is taking a more coordinated, comprehensive and consistent approach that brings various drivers together in a strategic approach with clearly defined priorities. Fisheries are being managed with explicit and transparent policy based risk boundaries within which industry can operate, which focus on taking account of the impact fishing has on the broader marine ecosystem. AFMA is currently progressing through implementing these initiatives to focus fisheries management with some work still to go.

Development of Scientific Tools to Support EBFM.
Presented by Tony Smith.

This talk discussed how policy and management needs have driven scientific tool development for EBFM in Australia. Key tools discussed included harvest strategies, ecological risk assessment, and management strategy evaluation. The first and last of these were illustrated using examples from the Southern and Eastern Scalefish and Shark Fishery (SESSF). The harvest strategies in the SESSF adopt a four tier approach to dealing with uncertainty, with the aim to have equivalent levels of risk across tiers. The MSE approach in the SESSF has been at

"whole of fishery" level, and is being undertaken using both qualitative and quantitative methods (the latter using the Atlantis modelling framework). The paper proposed a conceptual framework for tool development with axes including the type of tool (monitoring, assessment, and MSE), the scope of analysis (population, ecosystem, socio-economic), and the method of analysis (expert judgement, empirical, model based).

Discussion

Discussion centred on the similarities and differences between the Maritimes Region and Australia in approaches to EBFM.

Both places have national policies that articulates the goals of EBM. Both places are facing similar strategic issues and drivers and are trying to implement EBM in a similar manner, although Australia has made considerable advances in implementation since the 2003 workshop in Nanaimo, British Columbia. Habitat impact and bycatch are the 2 main EBFM related issues, and both places are considering a similar array of management measures, including MPAs, to address these. As stated above, both places are experiencing institutional resistance from fisheries managers, although this is likely symptomatic of the change in culture occurring.

While there are many similarities in our approaches, there are also a number of key differences. For example, Australia has a clear policy that the fishing industry pay for services, while this is evolving in a piecemeal fashion in the Maritimes. Another difference is that Australia has a formal and objective means to establish EBM priorities. The Maritimes is only starting to consider how these are to be established.

A summary of strategies, decision support tools (both strategic and tactical), and tactics for EBFM being considered in the Maritimes Region was compiled (Appendix 5).

COMPARISON OF APPROACHES, STRATEGIES, AND TOOLS

The comparison of approaches guided discussion on the common elements and their differences, which helped to develop an appreciation of the key issues that warrant further in-depth exploration. Specifically, the intent of this session was to explore in more detail specific technical tools (e.g., qualitative and quantitative MSE) that can, and are, being used by each country for EB(F)M.

Presentation Highlights

Incorporating Economic Objectives into MSE, Assessments, and Harvest Strategies.
Presented by Cathy Dichmont.

An integration of new and old methods is necessary to produce useful information and tools for operationalising EBFM. This means identification of biological and economics effects of fishing on target species, benthic habitats, and bycatch. MSE is a useful tool that allows fisheries managers to identify the trade-offs of different management options.

Target species research has developed the MSE Framework, which is used to manage a simulated resource and thereby test different management options. This framework has been extended to include the economics, effects of trawling on the seabed, and bycatch. However, experience has shown that retrofitting the original MSE model to include economics caused

major changes to every aspect of the model. It is recommended that the process begin by integrating all aspects of the issue rather than the often-used process of starting with biology, and then adding economics.

Risk assessment is a technique used to assess the potential risks that fisheries impose on a large number of species without resorting to data-intensive and time-consuming single species stock assessment approaches. A quantitative fishery risk assessment of bycatch has been developed that calculates impacts and suggests a useful reference point. With presence-absence survey data and knowledge of the spatial extent of the fishery, this model allows, over a large number of species, identification of species at risk. This approach is referred to as the "Cleveland method".

Ecosystem Models and Management Strategy Evaluation in Australia.
Presented by Beth Fulton.

Ecosystem Based Management and, in particular, the management of natural resources within that context has become a prominent issue for management and the public, political, and scientific arenas. Clear, effective tools with a long and well tested history of use do not yet exist for EBFM. Prototype methods have been developed, but it will take some time for their adaptation from other fields to be completed and for an experience base to grow around their use. Adding to the complicated and often tentative nature of the field, the very nature of EBFM has resulted in obstacles to its easy implementation. There are a large number of potentially competing stakeholders with conflicting or diverging interests; the systems are driven by a wide range of driving forces and components (environment fluctuations, predation, competition, pollution, fisheries, economics, social dynamics, or inertia); and as a result, there is a greater dimensionality to the uncertainty, right down to how (or even if) ecosystems can be manipulated to best meet stated objectives. Within Australia, models have been recognised as a useful tool for EBFM. They also play an important role as a "sounding board" for suggesting, developing, testing, and trialling alternative tools for use in EBFM, including monitoring and assessment methods, and (most importantly) highlighting trade-offs that arise between objectives. This work has largely been done within a management strategy evaluation framework (Butterworth *et al*. 1997, Sainsbury *et al.* 2000), and models have been developed with this explicitly in mind.

A wide range of models have been used in Australia, including multispecies models (Sainsbury 1991); statistical analyses (Norm Hall, Murdoch University, Western Australia); qualitative models and network analyses methods; and quantitative whole-of-ecosystem models, such as Ecopath with Ecosim (EwE; Christensen and Pauly 1992, Walters *et al.* 1997), Atlantis (Fulton *et al.* 2004) and InVitro (Gray *et al.* 2006). All of these modelling approaches have their strengths and weaknesses and are solid tools that can play a decision support role if used carefully and intelligently. For example, EwE has many components, including biological, fisheries, and some economics and policy search options (Christensen and Pauly 1992, Walters *et al.* 1997). Its popularity within the broader resource management and ecological community has only grown as it has becomes more modular and can be tailored to user needs more readily. In contrast, Atlantis and InVitro tackle a slightly wider set of sub-models, explicitly including dynamic representations of each facet of the adaptive management cycle. While both are heavily process-based, Atlantis takes a deterministic approach, while InVitro is a hybrid model making effective use of an agent-based structure to tie differential equation and individual-based models together. Atlantis and InVitro have not seen as much broad exposure as EwE, but they have performed well where applied. Atlantis has seen more use to date and has already given solid insights into aspects of EBFM, monitoring and assessment in particular, and has proven to be a good hypothesis generation tool (Fulton *et al.* 2005). InVitro has been applied more for multiple-use-management and has shown the costs and benefits of true

integrated management at the institutional level (Little *et al.* 2006). While both Atlantis and InVitro are more complex to implement than EwE, there are payoffs with regard to the flexibility and range of questions that they can be challenged with. The key is, however, to use the best tool for the job, and ecosystem models are only one tool. Qualitative modelling (Dambacher *et al.* 2003), for instance, is one tool whose value should not be overlooked. This kind of tool consideration is critical given the many issues (weaknesses) that are associated with ecosystem models that may take a long time to resolve satisfactorily. For instance, data quality and coverage will probably always remain an issue for ecosystem models simply because of the immense size of the task at hand to completely sample all system components. Uncertainty and the treatment of model parameter and structural sensitivity are also likely to be long-term concerns as existing methods are simply inadequate and alternative methods of coping with this issue (for instance bounding plausible solution space) are currently rudimentary at best. Lastly, given the attention focused on (and probable importance functionally of) biodiversity, its successful inclusion in models of any form remains a major future research goal. As with all EBFM tools it is early days but exciting times.

Ecological Risk Assessment for Effects of Fishing (ERAEF).
Presented by Tony Smith.

This talk provided further detail on the methods for ecological risk assessment developed by CSIRO and AFMA. Key features of the ERAEF method include its hierarchical organization, its precautionary approach to uncertainty, its efficiency as a screening and prioritization tool, and the value of having a consistent approach across fisheries. It has so far been applied to about 30 sub-fisheries managed by AFMA. Key limitations include that it only estimates potential rather than actual risk (until Level 3 in the hierarchy), that some aspects of management mitigation are not properly accounted for, and that further work in required on community analyses and on cumulative impacts. Its main value to date has been to prioritize issues for further analysis and management response.

The hierarchical approach is arguably the key innovation in this method. The scoping stage initially identifies 1) lists of species, habitats, and communities that might be impacted by the fishery (called units of analysis); 2) a list of activities (potential hazards) associated with the particular fishery; and 3) management objectives and current management arrangements in the fishery. The Level 1 risk analysis then assesses, for each of 5 components (target species, bycatch species, protected species, habitats, communities) the likely level of impact from each activity (including some factors external to the fishery). Only components that score at moderate or above risk are taken forward to Level 2 analysis. While the Level 1 analyses deal with whole components and not with every species, the Level 2 analyses assess all the units of analysis for each component brought forward from Level 1. Level 2 analyses consider explicitly the productivity of each unit of analysis and its susceptibility to impact from fishing. Thus, high risk units will have low productivity but high susceptibility. Level 2 analyses assess potential for risk or impact, but are not a direct quantitative estimate of risk. This comes into play at Level 3.

Discussion

It was agreed that economic objectives are a key driver for fisheries management as economically healthy fisheries are much easier to manage and more likely to achieve conservation objectives. While economic objectives are clearly stated in Australian fisheries legislation, they are not clearly stated for most Maritimes fisheries. While limit reference points are typically driven by ecological considerations, target reference points are often driven by economics (fuel, markets, etc.). In some Australian fisheries, incorporation of economic objectives has prompted more conservative (i.e., conservation oriented) fisheries targets than if

these objectives had not been included. Use of bio-economic models to inform fisheries management in the Maritimes Region was encouraged. There was interest in application of the Australian model for determination of bycatch risk to fisheries in the Maritimes Region. A constraint will be the lack of suitable fishing location information in some fisheries, e.g., lobster.

In Australia, social objectives are not addressed explicitly through bio-economic modelling but can come into play during MSE. MSE is designed to account for multiple objectives - it presents a range of scenarios for fisheries management and describes the possible consequences and trade-offs of each in terms of how well each objective is met under each scenario. It was recognized that social objectives may play a more prominent role in the Canadian context; however, these objectives have not been clearly articulated and, therefore, may be difficult to incorporate.

Concerns were expressed about the single-species approach to modelling. In addition to incorporating economic consequences into bio-economic models, it should be possible to incorporate ecosystem consequences (e.g., trophic impacts). Australia is in the process of modelling mixed species fisheries; progress on which will be useful to consider in the future.

EVALUATION OF APPROACHES AND TOOLS

The meeting reflected on a number of areas of joint interest, based upon the previous presentations and discussion. These are summarized below along with associated action items.

Analysis of Habitat Impacts

Habitat impacts and spatial management are important emerging priorities. There is a need to develop tools that allow habitat mapping in data poor areas. Notwithstanding this, habitat characterization and mapping require considerable investment, so there is a need to understand how spatial considerations will be used in management before developing the habitat mapping tools too much further. It was suggested that future collaboration could investigate how spatial habitat information might be used to inform management. Interest was also expressed in comparing and sharing tools and technologies for mapping and classifying habitats.

What is the role of spatial closures for EBFM? Spatial management is an increasing focus in Australian fisheries. The project described by Beth Fulton examined “mixed” management strategies that included several aspects of spatial management along with various mixes of input and output controls. In general, the mixed strategies outperformed strategies based on use of a single management tools (such as a quota management system).

In Australia, the intention is for MPAs to address a number of conservation objectives, while fisheries closures would complement these and address more fishery-specific issues. The best current example is the Great Barrier Reef (GBR), which is managed by the GBR Marine Park Authority. It has an explicit program that includes objectives to determine the best locations of spatial closures, taking account of the multiple uses of the area including fisheries, conservation, and tourism. There is also a national program leading to the identification of a National Representative System of Marine Protected Areas that aspires to meet “CAR” principles (comprehensive, adequate, and representative).

The meeting strongly encouraged the examination/evaluation of habitat and spatial performance in marine protected (and closed) areas, given experience with the MPA process in Australia. For

example, to what degree are the current management boundaries (time area closures) of fisheries meeting conservation objectives?

For the Maritimes Region, a logical next step would be further evaluation of the spatial characteristics of its fisheries. There is a need for improved accuracy in fisheries location information to inform habitat impact analyses. It was noted that technologies are available to provide accurate fisheries location information.

Discards/Bycatch/Incidental Catch

Both Canada and Australia face the challenge of monitoring discarding in a manner that is effective but affordable.

The Australian risk assessment approach (Levels 2 and 2.5) has proven to be very useful in determining priorities, but monitoring will need to occur more broadly to support assessments. The Maritimes Region should consider application of the ERAEF to some of their fisheries, at least for bycatch evaluation.

It was suggested that incentives for data reporting and mitigation activities be given careful consideration. For example, the ERA methodology is explicitly precautionary in the absence of data and information, providing an incentive for fisheries to collect relevant data. The ability to support monitoring (both fishery dynamics and economics) needs to be considered when determining monitoring programs/needs.

A key question is, “what level of discard mortality is ecologically acceptable?” At present, there is often insufficient information to address this. The Cleveland method (ERAEF Level 2.5) provides a method to evaluate impacts in data poor situations. This approach could be tried in the Maritimes to inform current bycatch work.

Monitoring

EBFM changes monitoring requirements. For example, there will be a need for enhanced monitoring of species composition in relation to bycatch, and of trawl location for habitat interaction. There is a need to continue to improve reporting of fisheries data relevant to the broader set of considerations in EBFM, including discarding. A strategic approach to monitoring taking account of the new management requirements of EBFM is required.

EMB does not require monitoring everything in the ocean. The priority is to monitor those aspects of the ocean of relevance to the evaluation of individual and cumulative performance of those activities in an ecosystem planning area.

CONCLUSIONS AND RECOMMENDATIONS

Insights

Comparative approach. There have been few opportunities to compare national initiatives related to EBFM. Maritimes and Australia have been pursuing similar paths on a similar time frame, and sharing experiences was useful. There are similarities in policy context and drivers for moving towards EBFM, and in the complexities of the institutional and political environment in which these changes are being implemented. Both face very similar challenges, for example,

in adequately monitoring to detect impacts of bycatch and discarding, or in evaluating and assessing impacts of fishing on benthic habitats.

Move from planning to execution. The meeting agreed that there is commonality in general understanding and need, and there is sufficient information (in the form of objectives and ecosystem overviews) to move from the planning stage to execution of EBM. However, EBM is still in its infancy and best practise has not yet been established. There is a need for case studies in application of EBM in both Canada and Australia. The structured approach used in the Maritimes Region of linking issues, strategies tools, and management measures was considered a useful framework. Australian experience with application of ERA, MSE, and bio-economic modelling was also very instructive.

EBFM versus EBM. There is a distinction between EBFM and the broader EBM in both Canada and Australia. The meeting suggested that fisheries can proceed with EBFM recognizing that the broader EBM agenda will continue to evolve.

Inclusion of social and economic objectives. Social objectives are implicit within fisheries management in the Maritimes Region. Australia has explicitly excluded social objectives from fisheries management, but it has included the idea of economic efficiency (although the most recent legislation includes more of the social objectives). The meeting recognized that more has been done on conservation objectives than on economic and social objectives (in that order). An important lesson learned in Australia is that incorporation of economic objectives after the fact resulted in considerable modification to the entire modelling environment and considerable duplication of research effort.

Structure. A structured process is required to successfully implement EBFM. A clear vision of the endpoint is necessary so that the process does not get stalled. The endpoint could be in the form of a revised fisheries management plan that incorporates EBFM objectives.

Prioritization and uncertainty. The ERAEF provides a structured approach for identifying risks of high priority. The MSE Framework is a practical way to investigate the implications of uncertainties in model structure and to identify procedures that are robust to these uncertainties without embarking on expensive monitoring programs that may be required to parameterize and test competing models. These methods presented by the Australians are considered very helpful to keep the procedures and integration simple and to communicate with fisheries managers.

Looking beyond Australia and the Maritimes. Given international interest in the topics, there was some discussion as to whether other nations, particularly those where there may be insights and innovations in EBFM, should also be approached about joint collaboration. It seems the most direct action has occurred in the Scandinavian countries and Iceland. These countries have classified their fisheries and inventories of objectives and activities with regard to whether the action/concern is already currently being addressed in some form, or was of low priority or (most importantly) a major immediate concern. A more formal process observed in South Africa and Namibia had used the Food and Agriculture Organization (FAO) of the United Nations guidelines to review their fisheries, associated issues, monitoring required, and the types of management and research that was yet to be done. While some of the other countries do not seem to have progressed towards action, it was noted that the USA had done a cross fishery ranking using pair-wise comparison. Aside from national initiatives, the Marine Stewardship Council had completed a review and expert consultation on alternative methods for progressing with EBM.

What will EBM look like and will it be the same the world over? It was thought that the objectives may be very similar but that tactical level implementations may see quite large variation (particularly as the systems themselves differ ecologically, economically, and socially). It was also pointed out that while large scale ecosystem modification to achieve desired outcomes has not typically been considered within the EBFM community in Australia or Canada, it has been proposed by some members of the global and even local communities. This is particularly the case when expanding to multiple use management where activities such as aquaculture will feature as part of coastal zone management and ultimately integrated multiple use management.

Take-home Messages

Fisheries management engagement. To be successful in implementing EBFM, considerable fisheries management engagement is required. Fisheries managers appear to be more engaged in this process in Australia.

Resources. To achieve EBFM requires money, resources, and expertise. A different group of experts will likely be required to develop/implement economic and social objectives than was required to develop/implement conservation objectives. Australia has a dedicated funding stream for directed research. Specific guidelines are required to govern the relative costs to government and stakeholders.

Template for DFO Science advice to Fisheries and Aquaculture Management Branch in the Maritimes. The meeting agreed that science advice to fisheries management should have an established protocol for EBFM completeness. The proposal was to use the template in Appendix 5 for the provision of advice to management. This template can also be used to prioritize science research objectives.

Explicit adoption of the vision articulated in the list of strategies and tactics as forming an EBFM approach that is under the umbrella of general EBM. This implies collaboration and integration with colleagues in other branches and departments, while still clearly indicating responsibilities. This should be very helpful in establishing a common framework for implementation in the longer term.

Stakeholder participation. The meeting agreed that stakeholder participation and education is essential. It is important to communicate the benefits of managing bycatch and habitat protection to industry and other stakeholders. There are often trade-offs that reduce industry profits in the short-term. There should be an effort to communicate benefits to stakeholders. The question of priorities among objectives remains: What is the appropriate trade-off between utilization versus conservation? Incorporation of social and economic objectives is necessary. We need to undertake the science required for development of scenarios that enable choices among a suite of objectives. There will need to be a political approach in both Canada and Australia to resolve these issues, as they are, in many cases, matters concerning social values rather than scientific debates.

MSE. There was discussion about whether or not to attempt a qualitative MSE for one or more stocks in the Maritimes Region. A number of the participants supported this approach. The MSE approach is a useful integrative tool that can be used to evaluate alternative adaptive strategies and highlights trade-offs across management objectives. It engages stakeholders to establish procedures that will be used to manage fisheries and could alleviate concerns about low credibility of limit reference points derived from objective, but uncertain, scientific principles. An

additional benefit that might accrue from this is that it may identify additional management tools needed to attain emerging objectives.

Next Steps and Potential Further Collaboration

Participants agreed that it could be valuable to continue to share methods and to inform one another of developments as EBFM evolves in both places.

The strongest area of agreement on the way forward is in collaboration on techniques and a comparison of techniques. This is particularly true for risk analysis tools such as ERA, but also classification schemes (e.g., the benthic habitat studies) and modelling work. Participants considered getting into a broader collaboration, perhaps under a Scientific Committee on Oceanic Research (SCOR) working group, on topics such as habitat mapping, validation of mapping techniques, and functioning of shelf regions around the world.

Based on the premise that by considering the same questions in a range of systems, greater understanding of many critical EBFM issues can be obtained, the following were identified as potential areas of collaboration:

Implementation of ERA within a Canadian context. It was recommended that one of the next steps in the Maritimes Region could be the application of the ERA method to one of its fisheries (this could later expand beyond fisheries to other sectors). It was recognised that this would require effort and expenditure in sending people to Australia (or vice versa) so that they could be led through the process; which by its nature can be hard to learn from a manual alone. This would also be a very useful test of the ERA method itself.

Benthic habitat classification sampling and methods. Meeting participants expressed a keen interest in collaboration on the testing and ground truthing of benthic habitat classification and impacts analysis methods. Both sides are well placed to make significant contributions in this area in terms of data and experience, and it would be fruitful to see some collaboration. Given the relevant experts and major players were not in attendance at the meeting, Tana Worcester and Tony Smith were identified as key contacts to ensure that this work proceeded. It was pointed out that beyond ground truthing the method, there is also a) the extension to consider how resilience is determined and what the associated reference points are; b) the on-going development of appropriate technologies for associated monitoring; c) the (potentially iterative) attention that must be put into survey design; and d) process understanding to identify appropriate benthic habitat predictors.

Communication of the benefits to the stakeholder. It was agreed that people engaged in communicating results need to think about what are the direct benefits, so stakeholders can appreciate why changes to regulation may benefit them. Given similarities in efforts, it would be useful to continue to share experiences.

Ecosystem comparisons and the role of multispecies models. The identification of implications (including benefits) can lead to an investigation of indirect effects, which can only be examined through ecosystem models. Experience with such models being what it is (gaining some critical mass, but still a large exercise in any one location), there is benefit in involvement in wider working groups. National initiatives that draw together experienced modellers are underway, but these are in their infancy. In many cases, the data are available and people are making conclusions, so there is an imperative to verify that these conclusions can really be supported more generally. A meta-analyses of shelf systems would be a tremendous product as it would provide context for EBFM. Agreement on this led to a more general discussion as to the form of

ecosystem status reports that are useful both as a synopsis of knowledge and also for management. It is critical not to lose focus on cumulative effects. This is perhaps a future topic for a workshop within the next year – how to integrate aquaculture and fisheries and other industries.

Large scale future needs. There was agreement that further exploration of methods such as the ERA would be useful, though only regional not national applications would be possible in the short-term. This would be a good place to start, as it would represent an expansion of existing methods, be a more comprehensive treatment, and so illustrate the prioritisation process. It is imperative that people with experience in the region become involved and dedicate time to this initiative. While the data collection can consume large periods of time, the analysis can be done within approximately two weeks.

Future workshops. The direction and need for future workshops was discussed with agreement that more targeted workshops on specific topics would be preferable in the short-term. This meeting was a good and necessary introduction, providing time to consider the issues and potential approaches. Further progress is dependent upon focused work. In the medium term, general meetings to review the overall state of collaborative efforts would be highly beneficial.

CONCLUDING REMARKS

The Co-chairs agreed that the report would be compiled and circulated after the meeting. The Co-chairs thanked the participants, rapporteurs, and local organizers. The meeting was adjourned.

APPENDICES

Appendix 1. List of Participants

Workshop: A Comparison of Australian and DFO Maritimes Approaches to Ecosystem Based Management

Hachey Conference Centre, Biological Station, St. Andrews, New Brunswick
3 – 5 October 2006

Participants

Participant	Affiliation/Address	Telephone	Fax	e-mail
Annand, Chris	A/Director, Fisheries & Aquaculture Management, Department of Fisheries and Oceans, PO Box 1035, Dartmouth, NS B2Y 1J3	902-426-3514	902-426-9683	AnnandC@mar.dfo-mpo.gc.ca
Bodsworth, Andy	Australian Fisheries Management Authority, PO Box 7051, Canberra Business Centre ACT 2610	61-2-6272-5290	61-2-6272-5175	Andy.Bodsworth@afma.gov.au
Bundy, Alida	Research Scientist, Population Ecology Division, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2	902-426-8353	902-426-1506	BundyA@mar.dfo-mpo.gc.ca
Burke, Les	Regional Director, Fisheries & Aquaculture Management, Department of Fisheries and Oceans, PO Box 1035, Dartmouth, NS B2Y 1J3	902-426-2583	902-426-7967	BurkeL@mar.dfo-mpo.gc.ca
Claytor, Ross	Manager, Population Ecology Division, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2	902-426-4721	902-426-1506	ClaytorR@mar.dfo-mpo.gc.ca
Dichmont, Cathy*	CSIRO, Marine & Atmospheric Research, 233 Middle Street, Cleveland, Queensland 4163	61-7-3826-7219	61-7-3826-7222	Cathy.Dichmont@csiro.au
Fulton, Beth	CSIRO, Marine & Atmospheric Research, Castray Esplanade, Hobart TAS 7000	61-3-6232-5018	61-3-6232-5053	Beth.Fulton@csiro.au
Gavaris, Stratis*	Research Scientist, Population Ecology Section, Department of Fisheries and Oceans, St. Andrews Biological Station, 531 Brandy Cove Road, St. Andrews, NB E5B 2L9	506-529-5912	506-529-5862	GavarisS@mar.dfo-mpo.gc.ca

Participant	Affiliation/Address	Telephone	Fax	e-mail
O'Boyle, Bob*	Associate Director, Science, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2	902-426-3526	902-426-5435	OboyleR@mar.dfo-mpo.gc.ca
Porter, Julie*	Head, Population Ecology Section, St. Andrews Biological Station, Department of Fisheries and Oceans, 531 Brandy Cove Road, St. Andrews, NB E5B 2L9	506-529-5925	506-529-5862	PorterJM@mar.dfo-mpo.gc.ca
Sinclair, Mike	Regional Director Science, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2	902-426-3490	902-426-8484	SinclairM@mar.dfo-mpo.gc.ca
Smith, Stephen	Research Scientist, Population Ecology Division, Department of Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, NS B2Y 4A2	902-426-3317	902-426-1862	SmithSJ@mar.dfo-mpo.gc.ca
Smith, Tim	Australian Fisheries Management Authority, PO Box 7051, Canberra Business Centre ACT 2610	61-2-6272-5631	61-2-6272 5175	tim.smith@afma.gov.au
Smith, Tony*	CSIRO, Marine & Atmospheric Research, Castray Esplanade, Hobart TAS 7000	61-3-6232-5372		Tony.D.Smith@csiro.au
Stephenson, Robert*	Director, St. Andrews Biological Station, Department of Fisheries and Oceans, 531 Brandy Cove Road, St. Andrews, NB E5B 2L9	506-529-5882	506-529-5862	StephensonR@mar.dfo-mpo.gc.ca
Worcester, Tana	Science Advisor, Centre for Science Advice, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2	902-426-9920	902-426-5435	WorcesterT@mar.dfo-mpo.gc.ca
Zwanenburg, Kees	Research Scientist, Ecosystem Research Division, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2	902-426-3310	902-426-1506	ZwanenburgK@mar.dfo-mpo.gc.ca

* Steering Committee

Workshop Participants

From left to right: Tim Smith, Ross Claytor, Alida Bundy, Tana Worcester, Les Burke, Mike Sinclair, Cathy Dichmont, Beth Fulton, Tony Smith, Chris Annand, Bob O'Boyle, Kees Zwanenburg, Julie Porter, Stratis Gavaris, Andy Bodsworth, Stephen Smith, and Robert Stephenson.

Appendix 2. Letter of Invitation

Fisheries and Oceans Canada | Pêches et Océans Canada

25 July 2006

Distribution

Dear Participant:

You are cordially invited to attend the October 2006 CSIRO Hobart – DFO Maritimes Workshop on Comparative Approaches to Ecosystem Based Management, to be held at the St. Andrews Biological Station (SABS) in St. Andrews, New Brusnwick, Canada during 3-5 October 2006.

Australia and Canada have been pursuing ecosystem based management (EBM) since the late 1990s – early 2000s. Both countries have made significant progress, with CSIRO Hobart and DFO Maritimes leading in development of approaches for implementing EBM. It is timely to undertake an in-depth comparison of scientific research and approaches for application of science in support of implementing EBM, discuss what has and has not worked from a technical perspective and give consideration to the broader framework used to guide EBM, particularly as it relates to the conservation objectives of fisheries. During the September 2005 ICES Annual Science Conference, M. Sinclair, K. Sainsbury, R. O'Boyle and D Smith met to discuss how best to undertake this comparison and suggested the current workshop. While the workshop will be focused on an ecosystem approach to fisheries, commonly referred to as EBFM, the lessons learned should be applicable to broader EBM efforts.

The workshop discussion and proceedings will be documented. In addition, dependent upon the outcome of the workshop, there will be an opportunity to prepare a paper synthesizing the main findings.

Terms of reference, a draft agenda and a list of invitees are attached. To facilitate focused discussion and exploration of the workshop objectives, participation is restricted to about 20 invitees.

The meeting will be held in the Hache Conference Centre, SABS, St. Andrews. We would like to begin the meeting promptly at 08:30 am, Tuesday, 3 October, so please plan accordingly. Consistent with the SABS Air Quality Policy, there is no smoking inside SABS buildings and staff and visitors are requested to please refrain from wearing scented products.

Please let Michele Saunders know at your earliest convenience if you will be attending, (1-506-529-5835 or saundersme@mar.dfo-mpo.gc.ca). Please note that you must book your room as per the attached instructions by **31 August 2006**. If you have any questions, feel free to contact me at 1-506-529-5882 (or stephensonr@ mar.dfo-mpo.gc.ca). I look forward to seeing you in St Andrews.

Sincerely

Original Signed By

R.L. Stephenson
SABS Director & Workshop Co-Chairman

Attachments

Canada

Biological Station
531 Brandy Cove Road
St. Andrews, NB
E5B 2L9

Tel.: (506) 529-8854

Station biologique
531 rue Brandy Cove
St. Andrews, N-B
E5B 2L9

Fax: (506) 529-5862

Appendix 3. Agenda

Workshop: A Comparison of Australian and DFO Maritimes Approaches to Ecosystem Based Management

Hachey Conference Centre, Biological Station, St. Andrews, New Brunswick
3 – 5 October 2006

Agenda[1,2]

3 October (Tuesday)

08:30 – 08:45	Introduction by Co-Chairs Rob Stephenson and Tony Smith
08:45 – 10:15	Policy Context (presentations of about 45 min from each of Canada and Australia) Describe recent policy developments for EBM and how this has or will change fisheries management plans and fisheries management, including: • Conservation objectives for fisheries – the broad goals and how do you see these translating into specific strategies • Changes to tactical management measures including spatial management initiatives such as MPAs • Fishery monitoring – responsibilities for new information needs and who will pay • Advisory institutional structure – the consultative and decision making process • Regulatory & enforcement institutions – how will modified and new tactical management measures be implemented and paid for *Canadian Ecosystem Approach to Fisheries: Management Perspective.* Les Burke *Policy Drivers for EBFM in Australia - Fishery, Environmental and Regional Marine Planning.* Andy Bodsworth
10:15 – 10:30	Break
10:30 – 12:00	Discussion of Policy Context Gain an appreciation of where EBM policy, with respect to conservation, is headed in each country. Develop understanding of similarities and differences in what is hoped to be achieved by EBM in each country. It is important to place the subsequent technical discussion in the broader national context, e.g. are there policy differences that require divergent practices, etc.
12:00 - 13:00	Lunch

[1] Timing includes presentation plus discussion.
[2] Breaks and lunches provided by the host.

13:00 – 15:00 Canadian Maritimes Approaches to EBM for fisheries

Describe approaches being pursued in the Canadian Maritimes to make the policies discussed above operational, with respect to conservation, including:

- Developing strategies, indicators, reference points, tactical management measures and decision or guide rules
- Process, consultation and stakeholder engagement

Canadian Maritimes Approaches to EAF: Chronology of Activities since 1997. Bob O'Boyle
Eastern Scotian Shelf Integrated Management (ESSIM) Initiative. Tana Worcester
Making Ecosystem Based Management Operational in the Fishery. Stratis Gavaris
Discussion and Lessons Learned

15:00 – 15:15 Break

15:15 – 17:00 Australian Approaches to EBM for fisheries

Describe approaches being pursued in Australia to make the policies discussed above operational, with respect to conservation, including:

- Developing strategies, indicators, reference points, tactical management measures and decision or guide rules
- Process, consultation and stakeholder engagement

Implementation of EBFM by the Australian Fisheries Management Authority - Progress to Date. Tim Smith
Implications of Policy and Management Needs for Development of Scientific Tools to Support EBFM. Tony Smith
Discussion and Lessons Learned

Evening Workshop Steering Committee meet to prepare a draft summary comparison of the approaches to guide discussion in the morning

4 October (Wednesday)

08:30 – 10:00 Comparison of Approaches

A summary comparison of the approaches will be presented to guide discussion on the common elements and their differences. This is to develop an appreciation of the key issues that warrant further in-depth exploration. Specifically, the intent of Wednesday's discussion is to explore in more detail specific technical tools (e.g. qualitative and quantitative MSE) that can and are being used by each country for EB(F)M.

Incorporating Economic Objectives into MSE, Assessments and Harvest Strategies. Cathy Dichmont
Ecosystem Models and MSE in Australia. Beth Fulton
ERAEF - Ecological Risk Assessment for Effects of Fishing. Tony Smith

10:00 – 10:15 Break

10:15 – 12:00	Exploration of similarities and differences between the approaches and the tools being used
12:00 - 13:00	Lunch
13:00 – 15:00	Further explorations (cont'd).
15:00 – 15:15	Break
15:15 – 16:30	Evaluation of approaches and tools After considering approaches and tools, there will be a discussion on broader related issues such as: • Comprehensiveness - any conservation elements missing? • Applicability to all fisheries, data rich and data poor • Extensibility to other, non – fisheries, sectors • How best to involve stakeholders
Post meeting	Workshop Steering Committee meets to prepare synopsis of the day's discussion
19:30	Dinner at the Rossmount Inn – organized by host, but pay your own

5 October (Thursday)

08:30 – 10:00	Synopsis of Approaches A discussion would be led on the lessons learned on the previous day with the general intent being to identify the elements of what participants agreed are important for EBFM.
10:00 – 10:15	Break
10:15 – 12:00	Consideration of Framework for implementing EB(F)M The discussion before the break would be continued to explore what changes might be required to be undertaken by the EB(F)M efforts of each country.
12:00 - 13:00	Lunch
13:00 – 15:00	Review draft proceedings
15:00	Adjournment

Appendix 4. Terms of Reference

Workshop: A Comparison of Australian and DFO Maritimes Approaches to Ecosystem Based Management

Hachey Conference Centre, Biological Station, St. Andrews, New Brunswick
3 – 5 October 2006

Terms of Reference

Context

Australia and Canada have been pursuing ecosystem based management (EBM) since the late1990s – early 2000s. Both countries have made significant progress, with CSIRO Hobart and DFO Maritimes leading in development of approaches for implementing EBM. It is timely to undertake an in-depth comparison of scientific research and approaches for application of science in support of implementing EBM, discuss what has and has not worked from a technical perspective and give consideration to the broader framework used to guide EBM, particularly as it relates to the conservation objectives of fisheries. During the September 2005 ICES Annual Science Conference, M. Sinclair, K. Sainsbury, R. O'Boyle and D. Smith met to discuss how best to undertake this comparison and suggested the current workshop. While the workshop will be focused on an ecosystem approach to fisheries, commonly referred to as EBFM, the lessons learned should be applicable to broader EBM efforts.

Objectives

The objectives of the workshop are to

- discuss experiences in Australia and Maritimes on the science in support of implementation of EBM, particularly as they apply to fisheries
- compare and contrast these implementations from a technical perspective
- consider the features of the framework required to guide EBFM

Outputs

The workshop discussion and proceedings will be documented. In addition, dependent upon the outcome of the workshop, there will be an opportunity to prepare a paper synthesizing the main findings.

Participation

To facilitate focused discussion and exploration of the workshop objectives, participation will be restricted to about 20 invitees. From DFO Maritimes, participation will be invited from Science, Fisheries and Aquaculture and Oceans Branches. From Australia, participation will be invited from CSIRO, and the Australian Fisheries Management Authority.

Appendix 5. Summary of Strategies, Decision Support Tools, and Tactics for Ecosystem Approach to Fisheries

		Prioritization Tool		
Prioritization of Strategies and Issues		ERA type of triage: 3 outcomes; not at risk, possible at risk > evaluate further, possible at risk>mitigate		
	Strategies (*indicator*)	***Strategic Tools***	***Tactical Tools***	***Management Measures***
Conservation				
Productivity				
Population Productivity	• Keep **fishing mortality** moderate	• YPR, production (Sissenwine-Shepherd), bio-economic, MSE	• assessment (VPA, SP,SSII, etc.), bio-economic	• effort limits, catch quotas
	- Promote positive **biomass change** when biomass is low	- YPR, production (Sissenwine-Shepherd), meta-analysis, historical recovery trends	- assessment (VPA, SP,SSII, etc.), bio-economic	- effort limits, catch quotas
	- Manage **discarded catch** for all harvested species	- judgment, HSE	- temporal/spatial distribution, gear selectivity, species composition	- gear specs, area/season closure, catch limits
	• Allow sufficient **spawning biomass** to escape exploitation	• production (Sissenwine-Shepherd)	• escapement survey	• gear specs, area/season closure, size limit
	• Target **% size/age/sex** of capture to avoid wastage	• market survey	• gear selectivity	• gear specs
	• Limit disturbing **activity in spawning areas/seasons**	• judgment	• learn from 'experimental management'	• area/season closure
Primary Productivity	• Control alteration of **nutrient concentrations** affecting primary production at the base of the food chain by algae			
Community Productivity	• Manage **trophic level removals** taking into account consumption requirements of higher trophic levels	• various 'ecosystem' models	• trophic studies, population assessments for 'key' species	• catch or effort limits (perhaps prohibition) on 'forage' species
	• Manage **total removals** taking into account system production capacity			• ecosystem yield caps

		Prioritization Tool		
Prioritization of Strategies and Issues		ERA type of triage: 3 outcomes; not at risk, possible at risk > evaluate further, possible at risk>mitigate		
	Strategies (*indicator*)	***Strategic Tools***	***Tactical Tools***	***Management Measures***
Biodiversity				
Species Diversity	• Control **incidental mortality** for all non-harvested species	• ERA level 2.5 (productivity), Pope et al 2000 method	• ERA level 2.5 (area overlap); Pope et al 2000 method, spatial distribution, species association (targeting/by-catch)	• catch cap, area/season closure
	• Minimize **unintended transmission** of invasive species			
Population Diversity (genetic)	• Distribute population **component mortality** in relation to component biomass	• population spatial structure	• survey, 'bar code' of life	• catch quota sub-allocation
Habitat				
	• Manage **area disturbed** of bottom habitat types	• MARXAN(modified)	• VMS analyses	• area closure, disturbance quota
	• Limit **amounts of contaminants, toxins and waste** introduced in habitat		• ERA level 1	
	• Minimize **amount of lost gear**	• judgement	• impact analyses	• gear specs
	• Control **noise or light level/frequency**		• ERA level 1	• codes of conduct
SOCIO-ECONOMIC				
	• Preserve peaceful communities • Foster stakeholder acceptance • Develop co-management			

Appendix 6. References

Butterworth, D.S., K.L. Cochrane, and J.A.A. De Oliveria. 1997. Management procedures: A better way to manage fisheries? The South African experience. In Global trends: Fisheries Management, pp. 83–90. Ed. by E.K. Pikitch, D.D. Huppert, and M.P. Sissenwine. American Fisheries Society Symposium, 20, Bethesda, Maryland.

Dambacher, J.M., H.W. Li, and P.A. Rossignol. 2003. Qualitative predictions in model ecosystems. Ecological Modelling 161: 79–93.

Christensen, V., and D. Pauly. 1992. ECOPATH II – A software for balancing steady-state ecosystem models and calculating network characteristics. Ecological Modelling 61: 169 – 185.

Fulton, E.A., A.D.M. Smith, and A.E. Punt. 2005. Which ecological indicators can robustly detect effects of fishing? ICES Journal of Marine Science 62: 540–551.

Fulton, E.A., M. Fuller, A.D.M. Smith, and A. Punt. 2004. Ecological indicators of the ecosystem effects of fishing: Final Report, AFMA Report R99/1546, Australian Fisheries Management Authority, Canberra.

Gray, R., E.A. Fulton, L.R. Little, and R. Scott. 2006. Operating model specification within an agent based framework. North West Shelf Joint Environmental Management Study Technical Report – Vol. 16, CSIRO, Hobart, Tasmania.

Little, L.R., E.A. Fulton, R. Gray, D. Hayes, V. Lyne, R. Scott, K. Sainsbury, and A.D. McDonald. 2006. Multiple use management strategy evaluation for the north west shelf: Results and discussion. North West Shelf Joint Environmental Management Study Technical Report – Vol. 18, CSIRO, Hobart, Tasmania.

Sainsbury, K.J. 1991. Application of an experimental management approach to management of a tropical multispecies fishery with highly uncertain dynamics. ICES Marine Science Symposia 193: 301–320.

Sainsbury, K.J., A.E. Punt, and A.D.M. Smith. 2000. Design of operational management strategies for achieving fishery ecosystem objectives. ICES Journal of Marine Science 57: 731–741.

Walters, C., V. Christensen, and D. Pauly. 1997. Structuring dynamic models of exploited ecosystems from trophic mass-balance assessments. Reviews in Fish Biology and Fisheries 7: 139–172.