Ecosystem Approaches and Oceans

Panel Presentations during the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (Consultative Process)
Seventh meeting, United Nations Headquarters,
New York, 12 to 16 June 2006

Division for Ocean Affairs and the Law of the Sea
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NOTE

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CONTENTS

TABLES

Page

FIGURES

Page

BOXES

Page

The following abbreviations have been used:

APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BCLME	Benguela Current large marine ecosystem
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CROP	Council of Regional Organizations of the Pacific
EAF	Ecosystem approach to fisheries
EAM	Ecosystem approach to management
EBM	Ecosystem-based management
EcoQO	Ecological quality objective
EEZ	Exclusive economic zone
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
ICES	International Council for the Exploration of the Sea
ICM	Integrated coastal management
IUU	Illegal, unreported and unregulated
LME	Large marine ecosystem
LOMA	Large ocean management area
MPA	Marine protected area
MSY	Maximum sustainable yield
NGO	Non-governmental organization
NOAA	United States National Oceanic and Atmospheric Administration
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
RFMO	Regional fisheries management organization
TAC	Total allowable catch
TROM	Target resources-oriented management
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

Foreword

The United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea was established by General Assembly resolution 54/33 of 24 November 1999 for an initial period of three years. The purpose of the Consultative Process is to facilitate the annual review by the General Assembly, in an effective and constructive manner, of developments in ocean affairs and the law of the sea. Also, the Consultative Process suggests particular issues to be considered by the General Assembly, with emphasis on identifying areas where coordination and cooperation at the intergovernmental and inter-agency levels should be enhanced. Thus far, the Consultative Process has been reviewed twice for its utility and effectiveness by the General Assembly pursuant to its resolutions 57/141 and 60/30 and extended each time for a further period of three years. Participants at the meetings of the Consultative Process are States Members and Observers to the United Nations, intergovernmental organizations and non-governmental organizations.

Each year, the General Assembly decides on one or two areas of focus for the deliberations of the Consultative Process. The area of focus for the seventh meeting of the Consultative Process was "Ecosystem approaches and oceans", which was organized as a panel discussion with four distinct segments, highlighting the many facets of the topic. In total, 20 individual panellists made presentations at the seventh meeting of the Consultative Process on the various aspects of the topic. Those presentations, whether in text form or an abstract thereof, as well as [the] corresponding PowerPoint® presentations, are the object of the present publication. The PowerPoint® presentations are contained in PDF format in the CD-ROM attached to the back page of the present publication.

The seventh meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea was held at United Nations Headquarters from 12 to 16 June 2006, under the guidance of Ms. Lorraine Ridgeway (Canada) and Ambassador Cristian Maquieira (Chile), as Co-Chairpersons.

Introduction

The seventh meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (Consultative Process) had as its topic of discussion "Ecosystem approaches and oceans".

The topic was initially somewhat controversial for some States given its breadth. For many others, however, it held the promise of clarifying at the international level definitions, concepts and implementation issues in order to aid its systematic application. Indeed, in the Review Conference on the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the United Nations Fish Stocks Agreement) of May 2006 and, in particular, discussions of article 5(d) of the United Nations Fish Stocks Agreement concerning ecosystem-based approaches, specific recommendations for greater implementation of ecosystems-based approaches to fisheries - even narrower than the Consultative Process discussions -- were inhibited (as noted by some States) by a general lack of detailed understanding of what its implementation entailed. In that context, it was hoped that additional clarity might be brought to the issue from the Consultative Process discussions the following month.

Thus expectations for the Consultative Process discussions were high. From the point of view of the Co-Chairpersons, the Consultative Process discussion, based on five panel segments and plenary discussions, proved to be informative and interesting. Therefore, the publication of the panel presentations by the Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs of the United Nations, is a very welcome initiative.

In general, it would be probably safe to say that, at the advent of the meeting and at the level of general policy, it was assumed that ecosystem-based approaches needed sophisticated data and knowledge, sophisticated modelling and fundamental changes to governance mechanisms, nationally and internationally, before implementation could begin. In short, an overwhelming task, which, it was argued, was inhibiting the implementation of ecosystem-based approaches, especially by developing States.

The panel segments supporting the plenary discussions were thus carefully planned, in order to address relevant issues in a building-block approach, with the overall emphasis being on “demystifying” both the concept and the implementation of the approach.

The first panel segment, which focused on definitional and conceptual issues, intended to highlight in a general sense, what an ecosystem-based approach might -- and might not -- imply.

The second to fourth panel segments then delved slightly deeper into: some specific enabling elements (ecosystem approaches to fisheries (the largest extractive activity in the oceans), science (data, knowledge and advice), large marine ecosystems (LMEs) as a basis for integration, and an example of a large-scale consultative process; lessons learned from national

application in developed States (as a proxy for application in information and governance-rich contexts); lessons learned in national experience from developing States (as a proxy for application in information and governance-poor contexts); and examples of application at the regional or global contexts (as an indication of application requiring international cooperation).

The extremely high quality and focused panel presentations, and discussions from engaged and interested delegations, led to a significant convergence of views in relation to the advancement of the concept and its application.

The overall report of the Consultative Process containing both "agreed elements" and a summary of discussions can be found in document A/61/156. Nevertheless, from the point of view of Co-Chairpersons, it is possible to summarize some basic breakthroughs in understanding of the issues among participants, along the following general lines:

(a) Ecosystem-based approaches relate to managing human activities in ecosystems, not "managing" or manipulating ecosystems themselves on the premise that human beings are part of ecosystems;

(b) There is no single definition or single way to implement ecosystem-based approaches to oceans, although the report of the meeting highlights some agreed components or aspects;

(c) It is, rather, an evolutionary, pragmatic, adaptive and interdisciplinary approach to management that can be applied flexibly in numerous contexts;

(d) There is no reason to believe that ecosystem-based approaches are not underway, or that their implementation cannot be effected now, even in limited ways initially. It is possible to get started at a small and simple scale -- often building on existing approaches. It was also clearly shown that there is a role for "pilot" projects, which can then be scaled-up into broader application;

(e) One does not need sophisticated ecosystem knowledge or models to get started in implementation at either the sectoral or cross-sectoral level (in terms of understanding the cumulative impact of activities on ecosystems or the effects of the ecosystem on the sustainability of specific activities). However, there are very sophisticated models in place, which play their role in pushing the frontiers of understanding and application;

(f) At the same time, the greater the knowledge gaps, or the smaller the planning scale in relation to the ecosystem in question (i.e., the more simple the application), the more precaution must be taken in planning for oceans' activities. This entails both stakeholder buy-in and political will;

(g) The meeting usefully distinguished between sectoral approaches to ecosystem-based management (EBM), and integrated oceans' management. Ecosystem approaches need to be applied rigorously in a sectoral context -- such as ecosystem-based approach to fisheries -- but while necessary, this is not sufficient for an ecosystem-based approach to oceans. The second key aspect of EBM -- integrated cross-sectoral management -- is also necessary, but not

sufficient to fulfill an ecosystem-based approach to oceans. In other words, the sectoral "legs" of the integrated cross-sectoral management planning "table" are critical, if integrated decisions and mechanisms (e.g., marine protected areas (MPAs)) are to be relevant and enforced in implicated sectors;

(h) Ecosystem-based approaches to management require integrated information and knowledge within and among oceans' sectors, which generally do not sufficiently exist. This will mean integrating data, information, disciplines and cultures, and ultimately, the provision of integrated advice relevant to management planning;

(i) Information, management and governance are all critical, but so are incentives and disincentives to ensure behaviour consistent with sustainable ecosystem-wide outcomes;

(j) There is a critical need for knowledge transfer and capacity-building -- in all States but especially in developing States;

(k) Integration and "synergy" are critical -- across data and management tools, within and across sectors, across borders and indeed across international organizations engaged in the issue (including those most specifically addressing different aspects of biodiversity).

The presentations also showed that much more is underway than had been understood, even at the level of quite sophisticated planning and practice. Nevertheless, much remains to be done -- especially to tackle issues on the high seas where knowledge and governance systems remain weak. But, overall, the glass must be seen as "half full" and not just as "half empty". Full-scale implementation is in progress in many contexts, and enabling conditions are otherwise being applied. Without such efforts the World Summit on Sustainable Development target of applying ecosystem-based approaches by 2010 could not be met. Particularly poignant is the role being played by Regional Seas projects and the important role of Global Environment Facility (GEF) financing in helping with large-scale integrated applications in developing countries.

In relation to the World Summit on Sustainable Development targets, an unanswered question remains, which was not addressed by the panel segments: "How will we know what progress has been made in implementing ecosystem-based approaches?" This is food for future thought as we move towards target dates and future review processes, such as the Commission on Sustainable Development discussion of oceans in 2014.

Lorraine Ridgeway and Cristian Maquieira
Co-Chairpersons, Consultative Process

PANEL PRESENTATIONS

PART ONE
DEMYSTIFYING THE CONCEPT AND UNDERSTANDING ITS IMPLICATIONS

I. IMPLEMENTING THE ECOSYSTEM APPROACH IN OCEAN AREAS, WITH A PARTICULAR VIEW TO OPEN OCEAN AND DEEP SEA ENVIRONMENTS: THE IMPORTANCE OF ANALYSING STAKEHOLDERS AND THEIR INTERESTS [1]

Introduction: describing the ecosystem approach

The culture and attitudes of humans are the most important factors in our aim for sustainable development. By putting humans and their uses of space and resources at the heart of the decision-making process, the ecosystem approach recognizes humans' responsibility and provides us with the opportunity to look comprehensively at all dimensions of the problem and to find management solutions based on the coordinated action of society, at different levels. Such solutions may imply trade-offs, but will benefit all in the longer term.

At the same time, the ecosystem approach takes into account the interactions and interdependencies between all the compartments of the ecosystem since management concerns marine life and the marine environment as much as humans.

A. BUILDING BLOCKS OF THE ECOSYSTEM APPROACH

There is no one "correct" way to implement the ecosystem approach and there are many different "ecosystem approaches", including:

(a) The ecosystem approach under the Convention on Biological Diversity (CBD) ecosystem approach, which aims at achieving conservation and sustainable use of biodiversity and the equitable sharing of benefits derived from its use;

(b) The ecosystem approach to fisheries (EAF), which focuses on sustainable use of fisheries and is conscious of the structure and function of ecosystems and their components, as well as the needs and desires of societies;

(c) Integrated marine and coastal area management, which is a multidisciplinary process providing for integration of sectors, levels of government and communities in the protection and sustainable development of coastal resources and environments; and also the oldest integrated management approach applied in the marine environment, and therefore the most widely practiced – for more than 40 years now.

B. PRINCIPLES AND GUIDANCE OF THE ECOSYSTEM APPROACH

Each of these ecosystem approaches is implemented in accordance with a definition, a set of principles, guidance and/or guidelines. An analysis of principles and guidance related to these three ecosystem approaches shows that there is good consistency among the approaches.

[1] Presented by Salvatore Arico, United Nations Educational, Scientific and Cultural Organization (see annex).

These principles and guidance are, in essence:

(a) Ecological relationships between harvested and associated species should be maintained; management measures should be compatible with the entire distribution of the resource (across jurisdictional and other boundaries), and management boundaries should be adaptive;

(b) Multiple-use management is appropriate for most resource systems;

(c) Multiple sector involvement is essential to sustainable use of resources; in this regard:

(i) Special forms of economic and social benefit evaluation should be used;

(ii) The impact of sectoral activities on ecosystems should be assessed;

(iii) Increased intersectoral communication and cooperation should be ensured;

(d) A major emphasis of resource management should be to conserve common property resources, thus measures should encompass the effects of practices by all relevant stakeholders;

(e) All levels of governance must be involved in management and planning, with decentralization at the lowest possible level;

(f) The diversity of social and cultural factors affecting natural resource use should be recognized; in this regard, benefit-sharing should be provided and traditional resource management taken into due account;

(g) The precautionary approach should be applied because knowledge of ecological and also social systems is incomplete.

These principles and guidance are not limited to coastal areas but also apply to open ocean and deep sea environments. In fact, the ecosystem approach is not bound by jurisdictional limits but is rather informed by a mixture of ecological boundaries, spatial and temporal information on stakeholder uses, jurisdictional limitations, and a range of special management measures.

C. ENABLING COMPONENTS OF THE ECOSYSTEM APPROACH

A key enabling component of the ecosystem approach is to know

"Who does what and where?"

With regard to use of ocean space and resources – in other words, assessing the nature and scale of activities, this information can be obtained through the method of stakeholder analysis and participatory research. Knowing who the stakeholders are and what their interests and expectations are is central to successful implementation of the ecosystem approach.

Stakeholders are: groups affected by management decisions; groups concerned about management decisions; groups dependent on the resources to be managed; groups with "claims" over the area or resources; groups with activities that impact on the area or resources; and groups with special seasonal or geographic interest.

Stakeholder analysis is based on the following main criteria: the relationship to the resources; existing rights to the resources; unique knowledge and skills for the management of the resources and the area utilized; economic and social reliance on the resources; and present or potential impact of stakeholders' activities on the resource.

Stakeholder analysis is important in that it enhances understanding of the human influence on the ecosystem and its management, it helps identify existing patterns of interaction and it assists examining the compatibility and/or conflicts of multiple-use objectives.

D. STAKEHOLDER ANALYSIS IN THE OPEN OCEAN AND DEEP SEA ENVIRONMENTS

Stakeholders' interests in open ocean and deep sea environments have been identified, analysed and preliminarily weighed. This has been done in the context of a project implemented by the United Nations University-Institute of Advanced Studies, with the collaboration of the United Nations Educational, Scientific and Cultural Organization (UNESCO). [2]

Research has shown that in the open ocean and deep sea environments two stakeholders are dominating: those involved in shipping/marine transportation and those involved in fisheries. However, many others are also present and show interest in ocean space and resources, possess unique knowledge or skills for the management of those resources, have a historical and cultural relationship to the resource and rely on the resource for their economic subsistence. These stakeholders are the telecommunications industry, the oil and gas industry, the scientific community, the military, the pharmaceuticals and biotechnology sector, non-governmental organizations, and traditional and indigenous communities. The activities by these stakeholders do have an environmental impact, at various degrees, but they are poorly coordinated with each other, and generally the sharing of benefits derived from the utilization of the resource in question is not foreseen. Overall, the implementation of the ecosystem approach in open ocean and deep sea environments has been minimal.

Mapping stakeholders is an important reality check towards implementing the ecosystem approach as it will allow identifying interests, the degree of stakeholders' interest, and their difficulties and/or incentives, in "joining the agenda". In this regard, experience in coastal and even in terrestrial areas shows that it is important to interact with individual sectors first and also that integration among sectoral policies can be complementary to the reinforcement of individual sectors.

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[2] M. Vierros, F. Douvere and S. Arico. *Implementing the ecosystem approach in open ocean and deep sea environments – an analysis of stakeholders, their interests and existing approaches*. United Nations University-Institute for Advanced Studies, Yokohama, 2006.

E. MAKING THE TRANSITION TO ECOSYSTEM APPROACHES TO OCEANS FROM CURRENT PRACTICES

In order to make the transition to ecosystem approaches to oceans from current practices, for ocean areas, the challenges lie in:

(a) Integrating the various management approaches into a comprehensive and cohesive plan with the ecosystem approach as its central framework, for example, through ocean policies, which could eventually be extended into the high seas;

(b) Management of oceans would need to be supported by information systems that integrate spatially;

(c) Referenced environmental data, stakeholder uses and jurisdictional boundaries;

(d) Most importantly, there is a need to reveal individuals, groups or organizations who are in one way or another interested, involved or affected (positively or negatively) by a particular project or action towards space and resource use (which is particularly true for open ocean and deep sea environments, owing to the out-of-reach nature of these environments).

It is clear that the ecosystem approach needs to be implemented holistically for ocean areas – as stated in the preamble to the United Nations Convention on the Law of the Sea (UNCLOS), which reads: "Conscious that the problems of ocean space are closely interrelated and need to be considered as a whole".

II. DEMYSTIFYING THE CONCEPT AND UNDERSTANDING ITS IMPLICATIONS [3] [4]

Abstract

Over the past 50 years, most efforts to regulate fishing and conserve our oceans have had limited success in preventing overfishing, degradation of the marine environment, and irreversible loss of marine biodiversity. Ecosystem-based management (EBM) of the oceans is an approach that is likely to succeed where many other initiatives have failed, because of its focus on managing human issues and impacts in order to achieve the maintenance of biodiversity. Fishing is an important use of the world's oceans, but the concept of EBM for marine capture fisheries has not been clear or fully operational. WWF has a comprehensive Policy Framework [5] designed to inform global debate and providing a workable approach for individual fisheries in a manner consistent with integrating global and regional policy initiatives into national activities.

Many different ways to refer to the idea of EBM of fisheries have successfully entered the politically correct scientific/managerial jargon [6] however, this apparent triumph conceals a bitter reality: the lack of a scientific and political consensus on the conceptual basis and limits of EBM, and the unavailability of an agreed operational framework generating clear rules for its practical implementation. Defining reference levels for fisheries management, based on indicators of overall ecosystem structure and functioning, and followed by the establishment of thresholds for overfishing an ecosystem, is crucial, to prove that EBM is much more than an appealing concept. This scientific advance must accompany the development of effective management approaches and operational tools (the EBM "tool kit") as well as political understanding of the nuances (and their operational effects) in the terminology employed by different stakeholders. These interrelated processes are key to the delivery of a truly functional approach that at its core enables society to continue to derive services from healthy functioning marine ecosystems.

Should the story of EBM become that of an interesting debate but a failed approach, the risk of a complete failure in ocean health and productivity is real. Our society, as users of the global marine resources, cannot afford a failure of EBM, given the cumulative scientific evidence on the degraded state of marine ecosystems and the way this compromises the future of the world's food supplies.

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[3] Presented by Simon Cripps, WWF-International (see annex).

[4] Mr. Cripps's presentation was prepared in collaboration with Katherine Short, WWF-International, Helen Fox, WWF-United States and Sergi Tudela, WWF Mediterranean Programme Office.

[5] T. Ward, T. Tarte, E. Hegerl and K. Short, Ecosystem-Based Management of Marine Fisheries - Policy proposals and operational guidance for ecosystem-based management of marine capture fisheries, WWF, Sydney, Australia, 2002.

[6] S. Tudela and K. Short, "Paradigm shifts, gaps, inertia, and political agendas in ecosystem-based fisheries management", *Marine Ecology Progress Series*, vol. 300, 16 September 2005.

III. WHY DO I CRITICIZE MSY THEORY IN ECOSYSTEM APPROACH? [7]

Introduction

Ecosystems, including those that contain fisheries resources, are characterized by uncertainty, dynamic properties, complexity and evolutionary responses of the component species. However, the classical maximum sustainable yield (MSY) theory does not include any of these (Matsuda and Abrams, 2004). Thus, it is perhaps not surprising that the MSY theory and its derivatives have not worked well for ecosystem fisheries management. Therefore, we said goodbye to the traditional MSY theory during my talk at the Fourth World Fisheries Congress in Vancouver, Canada, despite the fact that UNCLOS refers to the MSY theory.

A. SEEK SIMPLICITY, BUT DISTRUST IT

Even though many people encourage the ecosystem approach, I still prefer to encourage adaptive population management. Adaptive population management has had as yet few success stories. We require more experience in the adaptive management. In addition, as I will discuss later, the adaptive ecosystem management has a theoretical unsolved problem.

As Steve Murawski mentioned, complex models are not always powerful. I usually quote Alfred Whitehead's maxim, "seek simplicity, but distrust it". This is also quoted in a famous textbook on ecology by Begon and others (1986). I agree that many problems in marine ecosystem conservation are not solved by a single species model. I recommend making a model that only includes statistically/biologically indispensable factors to obtain reasonable results. I disagree with the approach that tries to include all known factors into a model. This is the case of trying to "seek simplicity".

Suppose a very simple population model:

$$N(t+1) = R\,N(t), \quad (1)$$

Where $N(t)$ is the population size of a species in year t, and R is the population growth rate. If R is larger than 1 and constant every year, $N(t)$ increases from year to year. I have a mathematical solution; $N(t) = Rt\,N(0)$. However, this is too simple. Owing to environmental limits, the population must stop increasing in some finite future.

On the other hand, I recommend making a model with errors or uncertainties. There are at least two types of errors with the ecosystem approach. Measuring errors means error in estimation of ecological states. Processing uncertainties means environmental and demographic stochasticity. Therefore, I recommend making a stochastic model:

[7] Presented by Hiroyuki Matsuda, Yokohama National University, Japan (see annex).

$$N(t+1) = R(t)\, N(t), \quad (2)$$

where $R(t)$ depends on year t. Note that this model is quite different from the model (1). Model (2) is trivially true by definition of $R(t) = N(t+1) / N(t)$. This model includes stochasticity in $R(t)$. Because some measurement errors exist, we just know the estimate of $N(t)$, hereafter I denote the estimate of $N(t)$ by $\tilde{N}(t)$. In the context of the maxim by Alfred Whitehead, "models with errors" means the phrase "but distrust it".

Therefore, I recommend making a "simple model with errors". That does not depict a unique future but projects interval estimate of future state. The risk evaluation is important for the uncertain future.

B. MAXIMUM SUSTAINABLE YIELD THEORY IS NOT BASED ON ECOSYSTEM APPROACH

The MSY theory recommends that the long-term yield be maximized at an intermediate stock's abundance (figure 1). The MSY theory guarantees the stock persistence because over-fishing does not pay the long-term yield.

Figure 1

A schematic relationship between stock abundance and surplus production of bioresource (the parabola curve). If the catch is 85 (tons) and the stock is between the open and black circles, the surplus production is larger than the catch, and the stock will increase until the black circle. If the catch is 125 (tons) and the stock is at the gray circle, this point is an equilibrium. This is called MSY. If the catch is larger than MSY, the catch is always larger than the surplus production and the stock will go extinct.

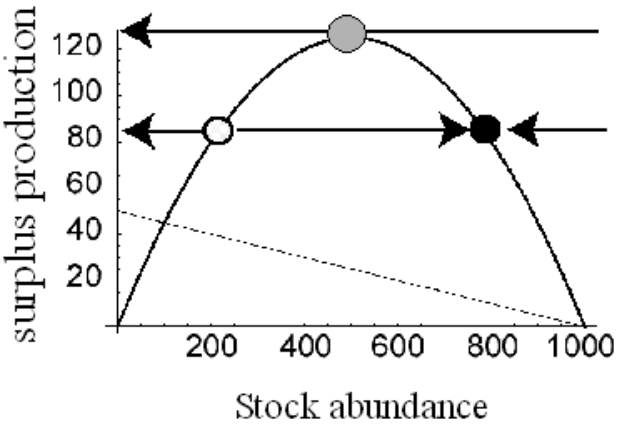
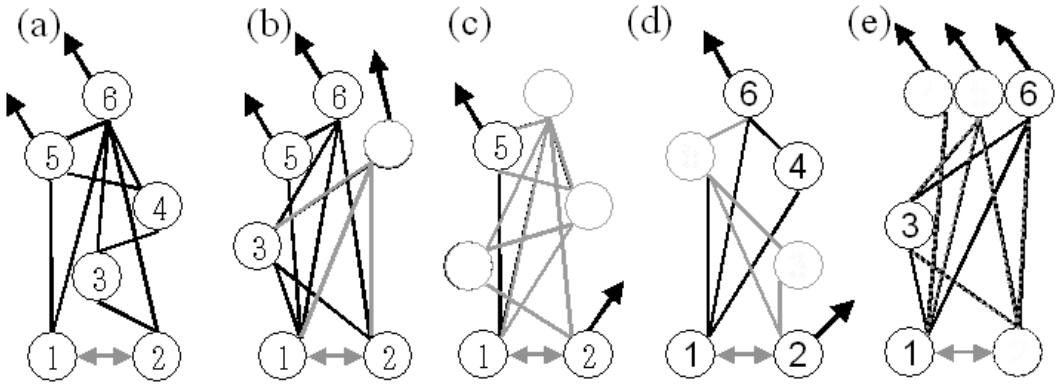


Figure 2

Five examples of the optimal solution that maximizes the total yield at an equilibrium. Numbered nodes mean species that persist and nodes without numbers mean extinct species. Edges mean the trophic link from smaller to larger numbered species. Species with arrows are exploited in each food web. Six species coexisting at the optimal solution is rare (panel a). At least one species went extinct at food web (b) to (e). The top predator (species 6) is either exploited or extinct (Matsuda and Abrams, 2006).

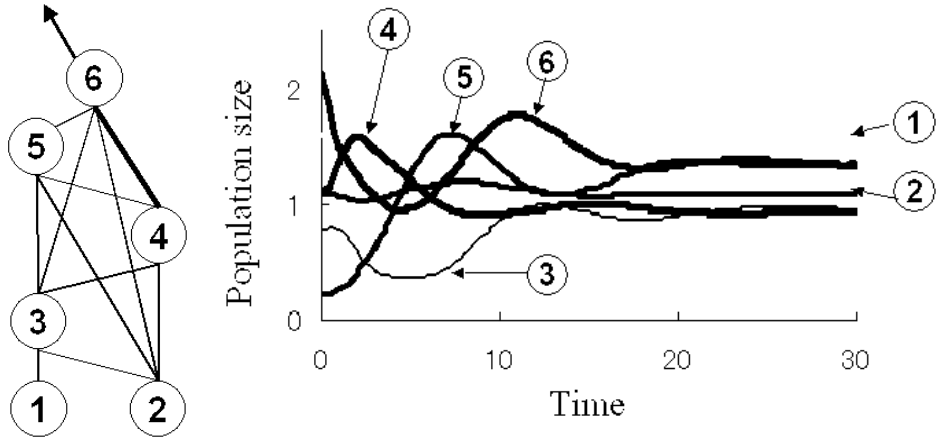


However, marine ecosystems are characterized as uncertain, dynamic and complex. The theory of MSY ignores all these characteristics. Peter Abrams and I considered the sustainable total yield from the whole ecosystem (Matsuda and Abrams, 2006). We considered randomly connected 6-species model communities, chose fishing efforts on these species independently, and obtained the optimal policy that maximizes the total yield at the equilibrium. The optimal solution does not guarantee species coexistence (figure 2). Therefore, we should explicitly take care of species coexistence in the whole ecosystem.

C. UNDERSTAND THE DIFFICULTY OF THE ECOSYSTEM APPROACH: INDETERMINACY IN INDIRECT EFFECTS; MYSTIFYNG APPROACH

Figure 3

A mathematical example of counterintuitive indirect trophic effect. Suppose a 6-species food web as shown in the left panel. Initially these species coexist without fishery and this population abundance reaches an equilibrium as time 0 of the right panel. If species 6 is exploited to some extent, this population abundance fluctuates and reaches a new equilibrium at time 30 of the right panel. Species 6 and 4 decreased by the fishing of species 6, while species 1 and 2 do not change this equilibrium abundance significantly. Species 3 and 5 increase their abundance.



It is intuitively expected that a decrease in predators will increase prey abundance. Suppose a three trophic-level system (e.g., a plant, its herbivore and its carnivore): decrease in carnivore will result in an increased prey abundance (herbivore), and consequently will decrease food (plant) resources. This is called trophic cascade.

D. TARGET SWITCHING IS ROBUST AND EFFICIENT

Make a falsifiable prediction

Adaptive management may not work in the ecosystem approach

The MSY theory does not guarantee coexistence of all species in the food web (Matsuda and Abrams, 2006). In addition, some may expect feedback control in fishing pressure as a robust strategy for management with uncertain, dynamic and complex ecosystems. However, feedback fisheries management does not always work for complex ecosystems. We investigated the effects of species interactions on sustainable yield from exploited multispecies communities. We considered the consequences of feedback control in fishing effort. If the prey species is exploited, increasing fishing effort decreases the predator abundance more than the prey abundance. Feedback control of fishing effort may cause extinction of the predator, even if the

fishing effort is well controlled. We recommend monitoring not only the target stock level but also any other indicator of the "entire" ecosystem. I propose the following principles: (1) do not catch fishes that are at low stock levels; (2) do not catch immature fishes but catch adult fishes; and (3) catch fishes that are temporally dominant. In order to achieve these three principles, (a) improve the technology for selective fishing; (b) monitor not only target species, but their prey, predators and the ecosystem (Matsuda and Abrams, in press).

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IV. TOP 10 MYTHS CONCERNING ECOSYSTEM APPROACHES TO OCEAN RESOURCE MANAGEMENT [8]

Introduction

Virtually every contemporary review of ocean and living marine resource management now includes a paean to ecosystem approaches to management (EAMs) or EBM. However, while the concept has become pervasive in the lexicon of ocean management, the general perception is that it remains largely an unfulfilled promise. Likewise, it is viewed in many circles as revolutionary -- requiring wholesale reassembly of policy-implementing institutions (Costanza and others, 1998), and in fact reinvention of science itself (Lubchenco, 1998). Given the rhetoric of revolution, and thus the prospects for institutional upheaval, it is not surprising that counter-revolutionaries exist (e.g., Corkeron, 2006) questioning the necessity for shifting approaches from a more traditional issue-by-issue focus. In many instances this "pushback" comes from entrenched sectoral interests (a sector defined as an interest group or activity that impacts or is affected by management decisions). Additionally, governance institutions managing these individual sectors may oppose the power sharing that would occur with broader stakeholder participation in decision-making. In the agency context there are issues of jurisdictional scale (local, regional, national) which lead to the fear of usurpation of control. Even at the national level, some agencies may fear loss of control of unique mandates; conflicts among mandates would be addressed under any concept of an ecosystem approach.

Generally, opposition to EAM is manifest not as people or agencies directly expressing their self interests in opposition to the approach, but by raising tangential questions about the specificity, maturity and validity of the concept, and lack of scientific readiness to support EAM. Thus, a series of common misconceptions or "myths" have evolved as arguments to delay, constrain or oppose implementation. Here I review 10 such common arguments and provide some thoughts on their origins and reasons why I believe they should be considered "myths".

A. MYTH #1: ECOSYSTEM APPROACHES TO OCEAN RESOURCE MANAGEMENT ARE NOT WELL DEFINED AND WE DO NOT KNOW HOW TO IMPLEMENT THEM

Reality: Ecosystem approaches to management have been extensively defined both in terms of their purpose and characteristics (Larkin, 1996; Fluharty, 2005). While there are many definitions of ecosystems, EAM and EBM, they invariably share a number of characteristics involving broadening stakeholder involvement, evaluation of multiple simultaneous drivers or "pressures" on ecosystems, and the fact that ecosystem approaches are geographically specified vs. being primarily species or single-issue driven.

One such definition of EAM is the definition adopted by the United States National Oceanic and Atmospheric Administration (NOAA) (it is by no means unique or exclusive of the others):

[8] Presented by Steven Murawski, United States National Oceanic and Atmospheric Administration, National Marine Fisheries Service (see annex).

> *An ecosystem [9] approach to management (EAM) is one that provides a comprehensive framework for living resource decision making. In contrast to individual species or single issue management, EAM considers a wider range of relevant ecological, environmental, and human factors bearing on societal choices regarding resource use.*
>
> *EAM is differentiated from more narrowly focused management approaches by a number of defining characteristics. EAM is: (1) geographically specified, (2) adaptive in its development over time as new information becomes available or as circumstances change, (3) takes into account ecosystem knowledge and uncertainties, (4) recognizes that multiple simultaneous factors may influence the outcomes of management (particularly those external to the ecosystem), and (5) strives to balance diverse societal objectives that result from resource decision making and allocation. Additionally, because of its complexity and emphasis on stakeholder involvement, the process of implementing EAM needs to be (6) incremental and (7) collaborative* (Sissenwine and Murawski, 2004).

Similarly the definition provided by the Food and Agriculture Organization of the United Nations (FAO) (2003) of ecosystem approaches to fisheries similarly emphasizes societal objectives, the broad range of ecosystem goods and services, and the integration of environment, ecology and human uses:

> An EAF strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.

EAM has been implemented in both formal (explicit) and informal (implicit) ways in a variety of institutional settings at local, national, and international levels, and implementation strategies include development of the policy, scientific and managerial resources and expertise necessary to manage using EAM. Increasingly EAM has been adopted in large-scale policy reviews, such as the United States Ocean Commission Report (USCOP, 2004), the European Union Marine Strategy, and the Canadian Oceans Act (Rice, 2005). As well, there is a growing body of experience among regional governance institutions moving towards more integrative approaches within the perceived scope of sectoral mandates (e.g., fisheries, energy production, coastal protection). While it is clear that EAM has been recognized at the highest policy setting levels, impediments remain including the asymmetrical benefits and perceived costs among various user sectors for participating in EAM-related activities. For example, while living marine resource management decisions clearly benefit from decisions regarding coastal water quality, water quality is (arguably) independent of decisions in, for example, fisheries

[9] An ecosystem is a geographically specified system of organisms (including humans), the environment, and the processes that control its dynamics. These definitions of EAM and ecosystems have been adopted by NOAA. The environment is the biological, chemical, physical, and social conditions that surround organisms. When appropriate, the term environment should be qualified as biological, chemical, and/or social.

management. As well, mismatches in the ability of science and policy to implement and support lead to differing perceptions about the readiness of each to undertake decision making under this concept, and to support decisions with meaningful scientific analysis subject to acceptable levels of uncertainty (Rice, 2005).

While there remain significant impediments to full implementation on the governance (Crowder and others, 2006) and science sides (Rice, 2005), the lack of full implementation should not be construed as our inability to define the concept or its attributes, nor that we do not know how the concept should be implemented in theory or in practice (Sainsbury and others, 2000; Garcia and Cochrane, 2005).

B. MYTH #2: EAM REQUIRES A "PARADIGM SHIFT" IN MANAGEMENT INSTITUTIONS AND SCIENCE SUPPORT

Reality: Many (if not all) marine resource management institutions throughout the world have adopted at least some of the EAM characteristics outlined in the answer to myth #1, as these institutions have evolved (Murawski, 2000). For example, increased interest in the effects of marine by-catch and habitat interactions of fishing methods have necessitated greater explicit consideration of these issues in fisheries management, reflecting increased emphasis on more diverse stakeholder interests and adapting to new scientific information. Likewise, impacts of energy exploration and extraction in marine waters are increasingly being viewed in the larger context of zoning to reduce impacts on biota. For example, the United States Minerals Management Service now requires pre-surveys of deep water lease sites prior to petroleum drilling to avoid impacts on biogenic communities and deep coral ecosystems. These mechanisms for incorporating broader perspectives in decision-making have occurred both by expansion of mandates within existing sectoral management, and by the adoption of new management instruments.

The notion that there must be a revolution in management institutions largely stems from the perceived failures of institutions to address degradation of the marine environment, declines in stocks, and conflicts among user groups (Costanza and others, 1998). Others argue that past failures, and in fact more recent progress, relates mostly to the effectiveness of these institutions in implementing mandates they already have (Mace, 2004). While this debate is largely one of semantics, the more important point is that institutions (be they existing or yet to be created) need to have operational, achievable objectives that can be accomplished on appropriate time scales in ways that are considered legitimate, transparent and fair by the sectors being regulated (Sissenwine and Mace, 2003).

With respect to science support for ecosystem approaches, a point that requires repeated emphasis is that ecosystem approaches require information about the interrelationships among ecosystem components informing policy choices (Murawski and Matlock, 2006). This does not necessarily imply that existing science and monitoring programmes should be abandoned, re-focused or even changed. In fact, many of the basic data on ecosystem components (fish surveys, water quality monitoring, habitat characterization) need to be expanded. The important new focus for science supporting EAM is in data integration across traditional disciplines at

appropriate geographic scales, and in understanding feedbacks and interactions among abiotic, biotic and human parts of the ecosystem.

The adoption of EAM as a management context is thus more accurately described as evolutionary (albeit with clear revolutionary tendencies).

C. MYTH #3: THERE ARE NO GOOD EXAMPLES OF THE ECOSYSTEM APPROACH TO MANAGEMENT IN PRACTICE ANYWHERE IN THE WORLD'S OCEANS

Reality: There are many compelling examples at the local, regional, and international levels where some or all of the EAM principles outlined in the answer to myth #1 have successfully been implemented as a basis for living resource management. For example, internationally, the Convention for the Conservation of Antarctic Marine Living Resources specifically has institutionalized EAM principles for the protection of key ecological relationships among predators and prey species, such as krill (Constable and others, 2000). At the national level, Australia, Canada, the United States, the European Union and other nations and groups have articulated ecosystem principles in their policies and laws. For example, the United States has incorporated protection of ecosystems in diverse statutes including its Endangered Species Act, Coral Conservation Act, Marine Sanctuaries Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act, and other statutes appropriate to the management of living marine resources. More comprehensive approaches to management of multiple activities occur through implementation of the National Environmental Policy Act, which requires comprehensive evaluations of proposed management activities, including cumulative ecological and social impacts in ecosystems. Regional and local examples are plentiful as well. While most of these examples have not implemented EAM comprehensively, and in fact may not even identify themselves as using ecosystem approaches, there nevertheless is a growing body of "best practices" of how to implement multi-stakeholder decision-making to affect ecosystem objectives of importance at these scales. Importantly, there has not been a comprehensive, systematic assessment of EAM implementation, and such a review would be helpful in developing future institutional and science approaches. In particular, the focus of such a review should be on outcomes.

D. MYTH #4: THERE IS INSUFFICIENT INFORMATION FOR ANY AREA CURRENTLY AVAILABLE TO ANSWER ALL THE ECOSYSTEM QUESTIONS NECESSARY FOR AN ECOSYSTEM APPROACH TO MANAGEMENT

Reality: As a comprehensive framework, EAM is supported by relevant biological, oceanographic, economic and social information appropriate to the problem set being managed. While there may be insufficient information to conclusively answer all technical questions regarding the impacts of particular policy choices, there usually is sufficient information to at least identify qualitatively the likely interactions among species and the directionality of particular human activities on biota and social and economic impacts. Adaptive management approaches incorporate new information as it becomes available, and identifies priorities for science to reduce uncertainty and improve understanding of the effects of policy choices. In many areas of the world, there is sophisticated ecosystem monitoring and research supporting management already in progress. An important aspect of science supporting EAM is that it

builds upon existing institutions and information collected for a variety of specific purposes, and provides a framework to combine these data in ways that add additional value to them. While, arguably, there is insufficient information to completely understand the many factors influencing any ecosystem, often it is not science that is limiting (Frid and others, 2006), but the will of political systems to make decisions in controversial circumstances (Sissenwine and Mace, 2003). More complete scientific information, models and analysis can help narrow the range of feasible solutions, but uncertainties in ecosystem responses will always remain. The challenge is to view ecosystem approaches as an opportunity to learn and adapt management measures based on the accumulation of knowledge.

E. MYTH #5: ECOSYSTEM APPROACH TO MANAGEMENT IS TOO DIFFICULT A CONCEPT TO APPLY IN MULTINATIONAL REGIONAL MANAGEMENT ORGANIZATIONS, AND ECOSYSTEM APPROACH TO MANAGEMENT CAN ONLY APPLY TO A FEW DEVELOPED COUNTRIES IN THE WORLD THAT HAVE THE TECHNICAL AND FINANCIAL RESOURCES TO SUPPORT IT

Reality: Regional EAM programmes are being implemented in a large and diverse set of the world's LMEs (LMEs; Hempel and Sherman, 2003). The LME approach takes advantage of natural boundaries in the world's coastal regions in terms of marine biodiversity, productivity and hydrography. Many of these LME regions overlap the territorial jurisdictions of multiple countries. In addition to the majority of coastal States bordering LMEs, the United Nations Environment Programme (UNEP) Regional Seas Programme, the Global Environment Facility of the World Bank and numerous regional management organizations support LME-scale science and management approaches. Significantly, many of these cooperative efforts are occurring in the developing world, and are strengthening regional science and management capabilities through the infusion of scientific and technical expertise and support for basic information collection supporting the development of these institutions. In fact, over $650 million in combined matching and grant support is presently invested in a global network of 17 LME projects either underway or planned, involving 121 developing and developed countries. Technical expertise provided by many countries has helped envision, develop and implement these programmes. A good example of the implementation of such a programme is for the Gulf of Guinea LME (West Africa). This cooperation involves Benin, Cameroon, Cote d'Ivoire, Ghana, Nigeria, and Togo. This programme has fostered cooperative projects on science, integrated management of living resources, and environmental restoration activities, using EAM principles. A more expansive Guinea Current LME project involving 16 regional partners is presently being implemented.

Importantly, EAM, like many multinational resource agreements, requires processes for resource allocation, assessment of resource condition, and management deliberation as conditions change. In principle, these three components are equally applicable to EAM as for individual resource sectors. The balance between conservation and utilization strategies will be a matter of societal choice and negotiation, consistent with the operating principles of any agreement. In fact, the relative success of the LME approach in developing nations is remarkable, and is perhaps indicative of the lack of institutional inertia that comes in situations where existing governance institutions and arrangements may resist change and evolution.

F. MYTH #6: THERE ARE NO GOOD SETS OF PRINCIPLES OR GUIDELINES FOR IMPLEMENTING AN ECOSYSTEM APPROACH TO MANAGEMENT

Reality: Principles and guidelines for the development of EAM have been articulated by a diverse set of sectoral interests both in terrestrial settings and for coastal and oceanic environments. For example, CBD (2006) has developed 12 principles of EAM:

(a) The objectives of management of land, water and living resources are a matter of societal choices;

(b) Management should be decentralized to the lowest appropriate level;

(c) Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems;

(d) Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach;

(e) Ecosystems must be managed within the limits of their functioning;

(f) The ecosystem approach should be undertaken at the appropriate spatial and temporal scales;

(g) Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term;

(h) Management must recognize the change is inevitable;

(i) The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity;

(j) The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices;

(k) The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Similarly, a number of groups have adopted sets of principles applicable to individual sectors, such as in fisheries (NOAA, 1999). FAO (2003; 2005) has articulated not only the principles of EAF, but a process for operational implementation (FAO, 2005; Garcia and Cochrane, 2005):

(a) Set high-level policy goals;

(b) Identify broad objectives;

(c) Prioritize issues to be addressed in management;

(d) Set operational objectives;

(e) Develop indicators and reference points;

(f) Develop decision rules for application of measures;

(g) Monitor and evaluate performance.

Sainsbury and others (2000) provide a comprehensive operational framework to operationalize ecosystem-based decision-making for fisheries, and sets of comparable goals and performance standards have been proposed for coastal zone management (Done and Reichelt, 1998). In principle, these implementation steps can be generalized to broader EBM. A particular set of principles applicable to management institutions is a matter of societal choice and degree of assumed risk for the consequences of particular management outcomes. Importantly, human values and value systems vary regionally, and even within countries and regions there can be vastly different perspectives from economic and ethical perspectives (Endter-Wada and others, 1998; Juda, 1999). Thus, the principles upon which these conflicts need to be resolved need to be informed by the diverse perspectives articulated at the geographic scales consistent with ecosystem definitions. However, given the globalization of marine economics, often value systems of distant consumers can impact on decisions made at local and regional scales (e.g., whaling).

G. MYTH #7: THERE ARE NO APPROPRIATE MANAGEMENT BENCHMARKS AND ASSOCIATED INDICATORS OF "SUCCESS" IN ACHIEVING ECOSYSTEM OBJECTIVES

Reality: While it is rather straightforward to establish management benchmarks for individual species for conservation and utilization purposes (e.g., population size thresholds and maximum removal rates), indices of ecosystem health and maintenance are more complicated (Murawski, 2000; Link, 2005; Daan, 2005; Livingston and others, 2005). This is because marine ecosystems have many more dimensions than do individual species (e.g., water quality, productivity at lower trophic levels, ecosystem 'balance" among trophic levels, and production of other goods and services). There are thus many candidate indicators and suites of indicators that can be employed as operational indicators of maintenance of ecosystem health. The final selection of appropriate sets of indicators for a particular EAM problem is dictated by the societal choice of what the goals of EAM are (Degnbol, 2005), and the feasible subset of those objectives that are consistent with societal priorities (e.g., it may not be feasible to simultaneously achieve biomass objectives for sets of interacting species). Thus, the choice of appropriate ecosystem metrics indicating "success" in EAM is context specific. As Degnbol (2005) observes, "Indicators represent the link between objectives and action in management". Thus, they represent not only a judgment about what society values from an ecosystem but a report card on the progress of management institutions in achieving strategic objectives. Performance management is a hallmark of political and government systems now, and this trend

will continue. One of the important components of selecting appropriate ecosystem indicators of successful achievement of management objectives is to be parsimonious in their selection, and to link the benefits of their achievement and the risks of failure to achieve them.

H. MYTH #8: A COMPLEX MODEL OF SPECIES INTERACTIONS AMONG ALL COMPONENTS OF AN ECOSYSTEM IS NECESSARY TO GUIDE AN ECOSYSTEM APPROACH TO MANAGEMENT

Reality: While complex models are useful for managing species that have predator-prey or habitat interrelationships, even qualitative understanding of these phenomena ("who eats whom", spatial distributions of key species and human use "footprints") can be used to establish cautionary management accounting for these potential interactions, particularly if the consequences may be great if the effects are not considered or cannot be quantified. Simple conceptual models of ecosystem function (including basic food webs) are helpful to guide the establishment of plausible subsets of potential outcomes, particularly in an adaptive management scenario, where provisional management policies are considered "experiments" for the purposes of gathering additional information. While complex models can, at the outset of a management programme, be used to quantify risks of policy alternatives, it is not necessary to have this information at the outset, assuming the range of possible system states in relation to proposed management alternatives can be outlined, and unacceptable outcomes and their potential risks. Of course, sophisticated modelling of ecosystem interactions and bioeconomic impacts of policy choices can help to articulate feasible subsets of management options, and to understand the benefits and costs of them. In the developed world often legislative or legal instruments require such evaluations. In this case, careful evaluation of options under these principles of benefits and costs can insulate difficult decisions from the accusation that they may be arbitrary or politicized.

I. MYTH #9: IT IS IMPOSSIBLE TO ESTABLISH THE BOUNDARIES NECESSARY TO DEFINE AN ECOSYSTEM APPROACH TO MANAGEMENT

As noted in the answer to myth #1 above, an ecosystem is defined as a geographically specific collection of animals, plants, and supporting environmental processes. That being said, the definition of appropriate scales for EAM is hierarchical in nature, and may change given the specific sets of problems to be addressed. For example, some problems may require that a specific bay or harbor be defined as a management unit for some particular purpose. However, because environmental regimes may apply over larger scales, and some animals have wide distributions, small-scale ecosystems defined for one purpose are imbedded in larger scales – up to the global scale. Specific criteria for ecosystem boundary definition have been applied to define LMEs, which is a useful compromise scale using patterns of biodiversity, productivity and hydrography to define ecological boundaries. Ironically, many argue that EAM should be applied to the smallest possible (local) scale, to allow co-management at the local level (e.g., see CBD principle (b) above). However, in doing so the number of interactions among adjacent local ecosystems and the necessity to coordinate for large scale phenomena, mean that more elements of governance need to be included as the focus of EAM becomes more local. Thus there is a paradox of scale that the smaller the spatial scale, the larger the number of involved entities may need to be involved in decision-making. It is important to stress that EAM is generally applied to ecological boundaries, which may or may not be coincident with

jurisdictional boundaries. The Gulf of Guinea example noted in the answer to myth #5 above is a good illustration of how country jurisdictional boundaries are imbedded within a larger set of ecological boundaries, which form the basis for cooperation in science and management activities.

J. MYTH #10: MARINE PROTECTED AREAS ARE AN ESSENTIAL COMPONENT OF AN ECOSYSTEM APPROACH TO MANAGEMENT

Reality: This is perhaps the most widely held misperception regarding ecosystem approaches (Sissenwine and Murawski, 2004). In fact, an EAM is not synonymous with MPAs, and thus one does not have to implement MPAs in order to be successfully managing resources using EAM. MPAs are increasingly being proposed for use as a fishery and ecosystem management tool, particularly given the advent of vessel tracking schemes and other border enforcement techniques that can help assure the integrity of their boundaries. However, MPAs are just one of a wide variety of management tools applicable to ocean resources. They are neither necessary in all cases, nor are they sufficient to guarantee the accomplishment management objectives (notwithstanding Allison and others, 1998; Lubchenco and others, 2003; Browman and Stergiou, 2004). Additional frequently used tools include prohibitions on specific activities or harvesting methods, the use of closed seasons for particular activities, input controls on the amount of regulated activities (e.g., fishing effort), output controls on natural resources extracted from ecosystems (quotas), and many other measures. Further, there is a continuum of types of MPAs ranging from short-term prohibitions on a limited set of activities, to include "no take" reserves and special management areas where most or all human activities are restricted or prohibited. While MPAs may be the most appropriate tool to accomplish some objectives (e.g., to protect highly sensitive marine habitat types such as deep corals), they often come with considerable costs to one or more affected constituencies. The social and environmental costs and benefits of any portfolio of measures need to be weighed carefully (as they should be with the implementation of any management tool used to conserve marine resources). The use of MPAs has to be considered carefully so as not to concentrate otherwise diffuse activities which may increase, for example, habitat damage owing to repetitive impacts, or in the displacement of activities to other, perhaps more vulnerable, areas or species.

Equating MPA and EAM/EBM is perhaps the most insidious of all the "myths". This is because many local groups and sectors oppose the implementation of specific MPAs (e.g., because of their allocative nature), or because one sector may feel particularly disadvantaged by their use (e.g., Lydecker, 2004). We must be careful not to equate the two, and conversely to articulate carefully the costs and benefits associated with the selection of any set of management measures. This includes implementation uncertainty in meeting objectives with MPAs, including enforcement risks as well as their ability, in concert with other measures, to meet cross-sector EAM goals.

K. FINAL THOUGHTS

The evolution of ecosystem approaches to management is moving at an uneven (punctuated?) pace driven by incremental developments in science and governance, which are on parallel but non simultaneous tracks (Rice, 2005). Many ocean-dependent sectors are now being

governed under some principles of EAM, even if they are not explicitly articulated as such. Evolution of governance will continue as long as governed sectors believe that the institutions are legitimate and transparent and there are adequate incentives to participate (Hanna, 1998). Objections to EAM have resulted when sector-specific management authorities feel that broadening governance to resolve mismatches (Crowder and others, 2006) dilutes their advisory or decision-making authority. Ironically, failure to do so may drive the search for alternative governance approaches that are less sectoral-specific. Individual sectors have opposed EAM because of their objections to specific measures (e.g., site-specific MPAs), which they perceive as linked to the concept. Development of the "rules of engagement" among sectors, either using existing institutions, or by using new advisory or decision-making bodies, is one of the critical next steps in the evolution of ecosystem governance.

While revised legislation and new international instruments can hasten the evolution of EAM, there is much the resource management and science communities and agencies can do now to increase communication, develop informal working agreements, and enhance coordination (all of which are required under EBM implementation strategies). Likewise, the science supporting EAM needs to progress quickly by integrating information across disciplines on appropriate regional (ecosystem) scales, and by prioritizing and coordinating data collection, experimentation and exploration activities consistent with issues identified by the management community.

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PART TWO
MOVING TO IMPLEMENTATION: IMPLICATIONS FOR ENABLING ELEMENTS

V. SCIENCE ADVICE SUPPORTING IMPLEMENTATION [10]

This brief talk considers three key science advisory elements supporting implementation of an EAM of human activities in the sea. The first is definition of the correct task; the second, the preparedness of science to advise on different aspects of implementing an ecosystem approach; and the third, the culture of seeking and using science advice in management of different human activities in the sea.

With regard to definition of the appropriate task for science advisors, many policy documents on an ecosystem approach propose three separate changes to how management approaches its task. These are placing management of individual human activities into an ecosystem context; integrating management of multiple activities in the same general area, and making the governance processes of human activities more inclusive and participatory. All three changes are interrelated, but that does not make them the same. Each needs to be considered in its own context, and receive the proper form of science advisory support. Importantly, it is highly unlikely that all three changes can proceed at the same rate in any governance regime particularly in ocean management, where there are many players in policy formation and management, each with primacy in different contexts.

Integrated management and inclusive governance are important to secure progress on ocean management, but neither may progress quickly. Meanwhile, to ensure that human activities in the sea are sustainable from an ecosystem context, there are benefits to focusing specifically on the management of each activity in a broad ecosystem context. It would be wrong to let the different – and usually slower – appetites of governments and industries for integrated management and inclusive governance be a brake on progress at implementation of ecosystem approaches to management of each activity. Moreover, the implementation concepts for ecosystem approaches to management simply move from accounting for linked ecosystem considerations of individual activities to acknowledging even more linkages when the governance systems are prepared to deal with truly integrated management. When governance empowers diverse stakeholders including commercial, recreational, and subsistence users of marine resources, dependent communities, and ardent conservationists all as stewards of the resources, it may influence the way decisions are made about the linkages and tradeoffs, but not the linkages themselves.

With regard to the preparedness of science to provide enabling support for implementation of an EAM, science advisory groups such as the International Council for the Exploration of the Sea (ICES) must meet three challenges – two posed by ecosystem "inputs" to the human activity and one by "outputs" of the activity to the ecosystem:

[10] Presented by Jake Rice, Department of Fisheries and Oceans, Canada (see annex).

(a) Taking account of the effects of environmental forcing (generally ocean and atmospheric physics and chemistry) on the dynamics of the resource being used in the human activity; this is usually clearest in fisheries, but not unique to fisheries;

(b) Taking account of the interactions among the biological components of the ecosystem - predator, prey and competitor interactions – such that perturbing one part of an ecosystem may have effects which could be either buffered internally or amplified as the initial perturbation spreads to predators and prey of the species initially affected;

(c) Taking account of the impacts of the activity on the ecosystem components; these can be direct or indirect, and intended or unintended.

Science advisors are not equally well prepared to provide useful advice for implementation in these three types of considerations.

Advisors are reasonably well prepared to address environment forcing, particularly in the northern hemisphere. Much is known about the patterns of the ocean and climate forcing functions, both spatially (e.g., current, upwelling, retention systems) and temporally (e.g., seasonal cycles, annual trends, decadal regimes). Much is also known about how these ocean processes affect a number of well-studied ecosystem components, particularly exploited fish and invertebrates. Much is not known, but enough is known for groups such as ICES to provide quantitative (or at least semi-quantitative) advice to managers and policy makers, and to test the robustness of the advice to reasonable hypotheses about plausible future states of nature.

For ecosystem effects of human activities, science advisory reviews have produced practical advice on the ecosystem effects of many individual human activities. Not all effects of any activity are equally well studied, and science advisory capability varies accordingly. However, in a number of jurisdictions, science groups have provided clear and often quantitative advice on the direct effects of fishing on target and non-target populations and on habitat features, and at least semi-quantitative advice on indirect consequences of the direct effects. The same has happened for the impacts of seismic sounds used in exploration for marine hydrocarbon deposits, marine gravel extractions, and other activities. Generally when science advisory bodies are asked to consolidate, review, and advise on risks and consequences of individual human activities in the sea, many uncertainties are present but useful advisory products also result. However, as illustrated with advice on sound in the sea, the science advisory process is vulnerable to politicization from several directions, and if it succumbs to any of them, the advice loses any scientific value – a point I return to later.

Although I had optimistic things to say about the preparedness of science advisory bodies to provide useful advice on environmental forcing and direct ecosystem effects of many human activities in the sea, the preparedness is much worse with regard to food web relationships among species. Quantitatively sound and rigorous models have proven difficult to develop and even more difficult to validate, requiring very large investments of science capacity. Models exist that demand much less information and are easier to use, but they are close to useless for real implementation in policy and management. Run correctly, the most they can tell managers is that heavily fished ecosystems have been perturbed too much, and they should be perturbed less in future. That is little help to managers and policy developers facing hard choices about

options with social and economic consequences. They need a quantitative reliability that simply isn't yet available for consequences of human activities, including fishing, on food web relationships among marine species.

Implementing an ecosystem approach to managing human activities in the sea will require building a culture of asking the right questions of science advisors at the right time in policy development (and that means early). It also requires building a culture among the science advisors of making the most of what we do know (which is not trivial), while taking adequate protection against the risks posed by what we don't know. These sound like platitudes when posed as general statements. However, experienced science advisory bodies work with different advisory cultures - between advisors and managers focused on activities like fishing, that primarily impact populations, and those focused on activities that primarily affect environmental quality and habitats. A move to an ecosystem approach will require these two cultures to merge. An EAM of fisheries, for example, requires placing population information into spatial contexts, to deal with environmental forcing and the effects of fishing on habitats and non-target species. Environmental health advisors generally work at spatial scales that are most meaningful to point-source impacts and the ecosystem processes they study, but, when brought into the science advisory processes, they have to adapt to working at the scales relevant to spatial management issues.

Adjustments to these expert attitudes are essential and won't come without encouragement. More importantly, the changes are not having either culture simply adopt the approaches of the other. Rather, some real integration of physics, chemistry and biology in space will be necessary for an ecosystem approach to have a sound science advisory basis.

This integration is proving harder than one might think and formal science advisory bodies such as ICES are finding progress slow. Meanwhile some experts are filling the gap with advocacy science, which is very different than giving the best advice possible with the information that is available without being stymied by information that simply is not known. It poses some of the most serious threats to sound, science-based implementation of an ecosystem approach, risking a culture of scientific demagoguery. Because developing policy is relevant but impartial and sound advice is difficult, and at the ecosystem scale the experienced advisory and management culture is still learning, we are seeing some science advocates turn the science problem on its head. They first choose a policy outcome they desire and then build a case for it by selective use of supporting evidence and ignore or intentionally discredit conflicting information. When governments or industries undertake such acts, they are widely and legitimately criticized as politicizing the science process. It is inappropriate when done by partisans on any side, however passionate in their concerns for our badly impacted marine ecosystems. Science advisors have their privileged access to policy and management because of their efforts to be relevant but impartial and empirical. The complexity of advising in an ecosystem context takes away none of the responsibility to continue to strive for objectivity and impartiality in their role in implementing the EAM of human activities in the sea.

This United Nations-based process is well positioned to make progress on these issues in the short term. The discussion last year of the Global Marine Assessment sketched out a process which has the potential to consolidate existing knowledge and produce assessments of the three

key science foundations of an ecosystem approach: knowledge of the major environmental forcers on system dynamics; knowledge of the current footprint of the major human activities on the marine ecosystems; and knowledge of the major interactions among species in the marine ecosystems. Careful attention to forming a balanced and objective group of experts to conduct such a global marine assessment will ensure credible products that are policy independent but also policy relevant. Moreover, at last year's discussion of the Global Marine Assessment, a proposal was brought forward to consider establishing a body for marine conservation issues that would function in a similar manner as the Intergovernmental Panel on Climate Change does for climate change science and advice. Such a body would be invaluable as a source of expert, objective analysis of risks and options associated with human activities in the sea. It could use the products of the Global Marine Assessment to provide a common and integrated information base for policy deliberations and decisions in the tough choices that lie ahead of all of us, in our search for strategies which ensure humanity benefits sustainably from the oceans, without causing serious harm to them.

VI. THE ECOSYSTEM APPROACH TO FISHERIES: IMPLEMENTATION FRAMEWORK AND AGENDA [11] [12]

Introduction

The ecosystem approach to fisheries recommended by the 2001 Conference on Responsible Fisheries in the Marine Ecosystem held in Reykjavik in 2001 was adopted by the FAO Committee on Fisheries in early 2003. The challenge is now about its implementation. This presentation deals with the definition and conceptual basis for EAF before elaborating on the implementation framework and reporting briefly on FAO work and reviewing the lessons learned, concluding on future developments. The structure of the text corresponds to the structure of the presentation and the various sections correspond to the different slides.

A. DEFINITION OF THE ECOSYSTEM APPROACH TO FISHERIES

The ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries

B. THE EXTENSION CONCEPT

EAF is defined as an extension of the conventional fisheries management with more attention to multiple objectives, cross-sectoral integration, biodiversity and environmental issues, multiple scales, adaptive learning, economic and other incentives, integration of all sources of knowledge, active participation, and transparency. The concept recognizes that EAF will only be successful within a complete and more effective implementation of the conventional approach. It charts, however, a route into informational, technological and institutional territories yet to be mapped.

C. IMPLEMENTATION FRAMEWORKS

Three different frameworks underpin the implementation of EAF:

(a) The normative framework consisting of the agreed high-level axioms, guiding principles and conceptual objectives;

(b) The cognitive framework through which information is acquired and analysed and turned into usable knowledge;

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[11] Presented by Serge Garcia, Food and Agriculture of the United Nations (see annex).

[12] The present paper contains the speaking notes used for a presentation made at the Consultative Process. It represents an abridged version of a more comprehensive one prepared for the Center for Oceans Law and Policy Conference on Law, Science and Ocean Management, Dublin, Ireland, 12-14 July 2006.

(c) The operational framework dealing specifically with the resources, institutions and processes mobilized for the implementation in the field.

Stakeholders contribute in various ways to the various frameworks. The need for guidance of all these actors is very significant.

D. FRAMEWORKS, ACTORS AND LINKAGES

The FAO Guidelines illustrate how the management scheme is scoped, specific objectives are set and rules are formulated giving the parameters for the action. The plan is then implemented, rules are enforced, indicators are monitored and reported. Information management and participation are important components of the process. Tactical performance is assessed regularly and frequently (e.g., on an annual basis). Strategic performance needs to be assessed from time to time (e.g., every 5-10 years, together with the national planning calendar). This process can be implemented at global, regional, national or ecosystem levels, even though the actors may be different or have different roles.

This guidance is still not "operational" enough to allow a Fisheries Department staff to implement the approach as each of the boxes in the loop calls for additional guidance regarding actors, means and resources, methodology, processes, criteria, and so on.

The type of information needed at each stage of the loop can be detailed as shown on the slide. However, even then, there is still a need to drill down, to further detail, for instance on the way to undertake a baseline assessment, to do an option analysis or to set up a system of observers. The advice required may be already available (e.g., in the numerous guidelines and manuals of FAO) or not.

The lower one drills down in the implementation chain, the more difficult it is to provide a one-fit-all guidance and the process of operationalization at site level will therefore always involve a great deal of customization.

E. IMPLEMENTATION BY THE FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Not enough time is available to explain in any detail the work done by FAO for the implementation of EAF. I will only mention that 40 per cent of the Fisheries budget of FAO is dedicated directly to implementing EAF and 60 per cent of it is contributing indirectly to it, both in the Regular Programme of FAO and its Field Programme.

F. IMPLEMENTATION BY REGIONAL FISHERIES MANAGEMENT ORGANIZATIONS

The types of action that have been undertaken or initiated by regional fisheries management organizations (RFMOs) include: (1) debates on the EAF issue and implications; (2) identification of key ecosystem issues; (3) collection of additional information; (4) holding of special working and advisory groups; (5) and discussion about collaboration with regional environmental commissions.

Regional fishery bodies have agreed on a number of non-binding measures and initiatives, for instance, to improve selectivity; develop ecosystemic assessment, improve monitoring and modelling; protect endangered species and habitats; reduce by-catch and discards; use the precautionary approach; develop educational programmes; establish catch documentation; consider pollution from ships and marine debris; and fight against illegal fishing.

Few binding measures have been adopted such as: formal adoption of EAF (in six bodies); by-catch reduction measures (in six bodies); habitat protection and MPAs (in two bodies only), and precautionary management and endangered species (in one body only).

G. LESSONS LEARNED

EAF has only been formally on the FAO agenda for 3 years but a number of things have been learned, in particular the fact that the viability of EAF depends on political, economic and social factors:

(a) Political viability factors include: an effective ranking of the multiple objectives; commitment and support of political leaders; support from the citizens; nesting EAF in nationwide policies; rapid production of positive outcomes (success stories); and emphasis on long- and short-term outcomes and benefits;

(b) Economic viability factors include: provision of appropriate incentives such as subsidies and taxes; clear identification of benefits and costs; the facilitation of an enabling environment for sustainable investments; availability of financing mechanisms for sustainable revenues (fees, taxes) to sustain the approach;

(c) Social viability factors include: the availability of alternative livelihoods to fishing; effective mechanisms for resolution of conflicts; development of awareness-raising, communication and education programmes; strong participation in decision-making and enforcement; accounting for cultural factors; and equitable distribution of resources, costs and benefits;

(d) Administration capacity. The existence of a sufficient administrative capacity (in the public and private sector) is an often forgotten sine-qua-non condition for success. Some of the key requirements are:

(i) An early identification of likely obstacles and means to overcome them;

(ii) Improved coordination between planning and management, across administrative and political boundaries, with financial institutions, development banks, and so forth; between countries sharing ecosystems, overcoming bureaucratic inertia;

(iii) Clear legal framework and jurisdictions defining responsibilities and ensuring accountability among ministries and agencies;

(iv) Agreed strategy and action plans, generated through a participative and transparent planning process;

(v) Deterrent penalties and credible enforcement by specially trained officers;

(vi) Adaptive management plan in place with objectives and indicators;

(vii) Adoption of minimum environmental norms;

(viii) Implementation of defendable use rights, integrating traditional rights;

(e) Research capacity. There is a need to upgrade research capacity to undertake monitoring and assessments. This requires the definition of meaningful boundaries of the ecosystems; improvement of data collection; recognition of uncertainty and risk; adopting a participatory integrated assessment framework and the undertaking of regular risk assessments and performance assessments; establishing systems of indicators and reference values; and improving ecosystem modelling based on complex systems theory.

H. CONCLUSIONS

We are still in the very early steps of implementation. Much guidance is available already and more will come as experience builds up. Customization needs to take place on a case-by-case. The implementation is absorbing most of the FAO-Fisheries budgetary resources. Regional implementation is very uneven and essentially embryonic. National implementation is very active in very few countries, and embryonic in most of the others. Nonetheless, the experience available yielded a long checklist of what needs to be done and taken into consideration.

The EAF "shock wave" will take some time to modify the bio-ecological, technological, economic, socio-cultural, institutional and legal components of the fishery system. It is probably unreasonable to expect an instant full-fledged implementation anywhere and a gradual implementation is more likely. However, a gradual implementation of a complex, systemic, approach is not without dangers. Developing a national framework is a priority which, unfortunately, is beyond the capacity of a Minister of Fisheries. The development of regional frameworks may not be straightforward beyond national jurisdiction, for example, to promote participatory research and decision-making.

A number of actions can already be taken and have received a lot of attention: formally adopting EAF; adapting legislation; capacity-building; mapping ecosystems, critical habitats, types of uses, and jurisdictions; identifying stakeholders, endangered species, gaps in knowledge and risks; developing systems of indicators; improving gear selectivity; placing MPAs where appropriate, and so forth.

These actions risk, however, being only "emblematic" measures, reflecting good intentions, but failing to produce the expected improvement if the root causes of unsustainability are not fully addressed.

Above all, therefore, the old problems of lack of use rights, wrong subsidies, ineffective enforcement, underfunded research, weak administrative structures, which are at the root of overfishing, illegal fishing, lack of equity and corruption need to be resolved.

VII. THE IMPLEMENTATION OF THE ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT IN THE BENGUELA REGION: EXPERIENCES, ADVANCES AND PROBLEMS [13]

The present paper has resulted from further development of a presentation given at the seventh meeting of the Consultative Process. It provides details on the development and implementation of the ecosystem approach to fisheries management in the Benguela region and was recently submitted at the Bergen Conference on implementing the ecosystem approach to fisheries, held from 26 to 28th September 2006.

Introduction

The Benguela Current ecosystem stretches along the south-west Atlantic coast of Africa from central Angola through Namibia to the south coast of South Africa, bounded by the Angola-Benguela Front in the north and the Agulhas Current in the south (from between roughly 14^{o} and 17^{o}S to between 36^{o} and 37^{o}S). As such, it covers the West Coast of South Africa, the entire Namibian coast, and southern Angola to an extent depending on the position of the Angola-Benguela front (figure 4).

The ecosystem is a highly productive one in terms of primary production and fisheries resources. It is also highly complex in relation to, for example, its oceanographic features (ibid.), trophic structure and human activities such as mining, oil extraction and fishing, all of which impact upon its biodiversity and ecosystem health. These human activities have important social and economic significance, providing important job and incomes for the three developing countries. For the living marine resources to be managed sustainably and the social and economic benefits to be maintained, it is consequently critical that their dynamics should be adequately understood and that the countries should introduce management strategies that preserve ecosystem health and minimize the risk of overexploitation (Cochrane and others, 2004, Roux and Shannon, 2004; Shannon and others, 2004).

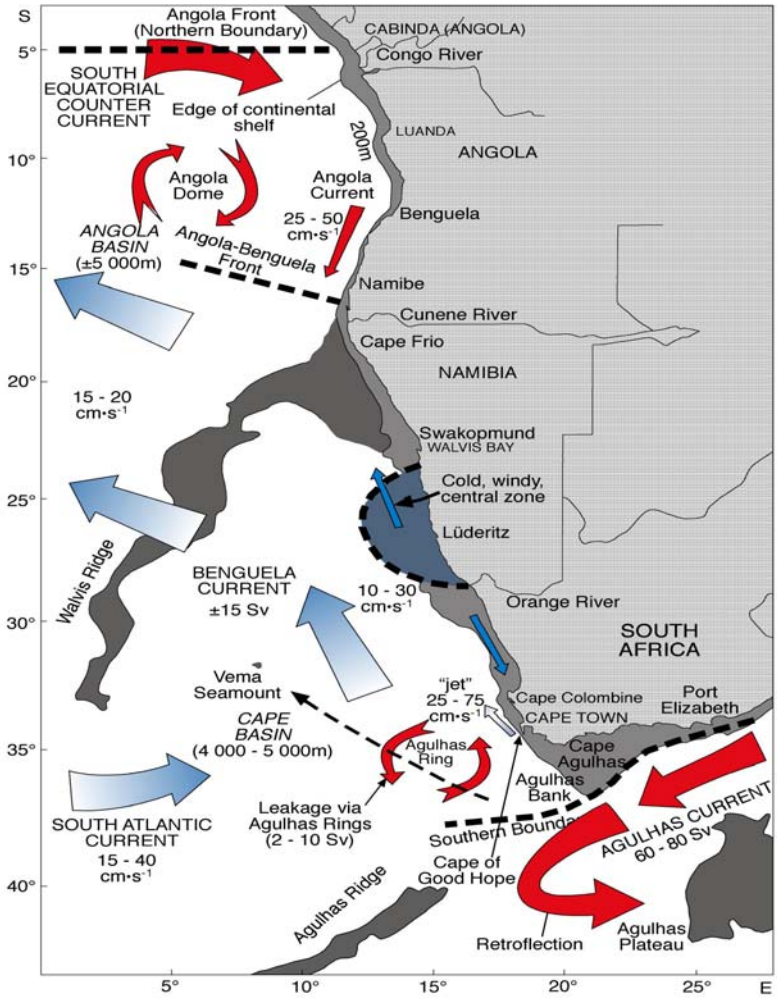
The region has long been at the forefront of ecosystem-based marine science. As long ago as 1991, South African institutions developed a multidisciplinary and multi-institutional research programme named the Benguela Ecology Programme (Moloney and others, 2004). The programme integrated physical, chemical and biological oceanography, ecosystem modelling, fisheries biology and stock assessment approaches in a way that allowed the first steps to be taken away from single-species management approaches only to addressing management of the ecosystem in a more holistic way. This resulted from improvements in understanding of the processes involved in production, retention and enrichment, trophic structure and functioning and the impacts of fisheries on various components of the ecosystem. By 1986, major strides had

[13] "The Benguela Current Large Marine Ecosystem Programme: implementation of an ecosystem approach to ocean governance," K.L. Cochrane, Food and Agriculture Organization of the United Nations; C.J. Augustyn, Marine and Coastal Management, Cape Town, South Africa; and M.J. O'Toole, Benguela Current Large Marine Ecosystem Programme, Windhoek, Namibia; presented by Michael O'Toole, BCLME Programme (see annex).

been made and published in a seminal symposium volume (Payne and others, 1987) followed up by subsequent work (Payne and others, 1992; Pillar and others, 1996). As government funding waned in the mid-1990s and the countries of the region began to work together in the post-apartheid period, it was realized that there was an enormous opportunity for improved understanding of the whole Benguela ecosystem by pooling resources across boundaries and tackling these issues on an ecosystem-wide basis. The answer was found in the establishment of a new marine science programme in 1996, the Benguela Environment Fisheries and Training Programme, initiated and funded by the three countries but strongly supported by Germany (through the German Agency for Technical Cooperation) on the environmental side and Norway (through the Norwegian Agency for Development Cooperation) on the resources side. The programme turned out to be highly successful, and further advances were made in the understanding of linkages between resources and the environment, as well as capacity building in these areas.

Aware of the complexity of sustainable management, the three countries with the assistance of GEF, subsequently jointly developed an integrated cross-sectoral programme to address transboundary human impacts on the ecosystem, namely the Benguela Current Large Marine Ecosystem Programme (BCLME). This initiative was developed over the period 1997-2001 and formally launched in 2002. Although the Programme considers the human impacts across all sectors, it particularly focuses on transboundary fisheries and management actions to derive sustainable economic benefits for the region. Further strides have been made in understanding environmental variability in the region and its impact on the productivity of resources. One of the key activities to be commissioned by the BCLME Programme was a project specifically designed to address the implementation of an ecosystem approach to fisheries management and this has allowed managers in the three countries to develop a philosophy and some practical measures to deal with impacts of fisheries on the ecosystem and its components, both within their own areas of jurisdiction and in a regional manner where certain fish stocks are exploited across borders. The present paper outlines the approach used by the project and some of the results achieved.

Figure 4
The boundaries, major currents and physical features of the Benguela Current large marine ecosystem



During the developmental phase of BCLME, there was an early realization that better understanding of the dynamics of the ecosystem and improved approaches in its management would eventually need to be backed, first, by political support at the highest level in order to achieve the economic benefits that seemed to be possible from these initiatives. Secondly, top managers would need to utilize the information being generated by the scientists to achieve the desired advances in management. The main output of the Strategic Action Programme of the BCLME initiative was to establish a formal Commission which would allow managers to access information on the status of resources and the ecosystem as a whole, and to agree on sustainable levels of utilization and reduction of negative impacts. The Benguela Current Commission was formally initiated in August 2006 with the signing of an Interim Agreement by the three countries and will allow managers to advise their Governments on these matters. It is hoped that by the end of the second phase of BCLME (2008-2012), a fully integrated Commission will have

been developed and signed with a legally binding Convention that will set terms over which total allowable catches (TACs) for transboundary resources will be negotiated bilaterally within the Commission between the neighbouring countries and outcomes will be enforced by the Commission.

A. TERMS OF REFERENCE OF THE PROGRAMME

The main objective of the project described in the present paper has been to investigate the feasibility of EAF management in the BCLME region through examining the existing issues, problems and needs related to EAF, and considering different management options to achieve sustainable management of the resources at an ecosystem level. Its scope included the following:

(a) A review of all the major target resources-oriented management (TROM) fisheries from an ecosystem perspective;

(b) Evaluation of the consequences of continuing with TROM approaches to the fisheries;

(c) Analyse the benefits and costs of implementing EAF and present them to managers and decision makers;

(d) Propose operational goals and objectives to implement EAF;

(e) Identify management measures and rules to achieve the best results within an EAF;

(f) Liaise with managers and decision makers to formulate preliminary management plans for EAF at national and regional levels;

(g) Develop improved techniques and approaches to strengthen the decision-making process;

(h) Identify useful ecosystem indicators and their application to characterize ecosystem states, changes and functioning;

(i) Identify research needs for improved EAF;

(j) Propose incentive measures to facilitate the implementation of EAF;

(k) Recommend appropriate institutional arrangements for successful implementation of EAF;

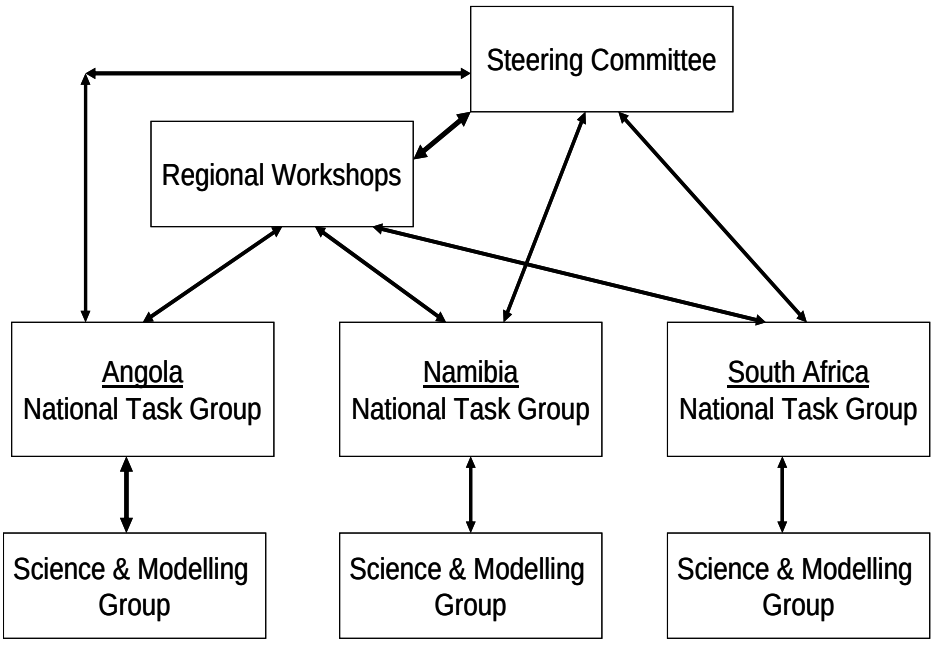
(l) Inform stakeholders of project results.

B. IDENTIFYING THE NEEDS AND PLANNING THE RESPONSES

The institutional structure of the project

EAF is as much about people and policy as it is about ecosystems. It is therefore essential that, from the outset, planning for EAF is conducted in a consultative and transparent manner that allows for interaction between stakeholders, managers and those providing scientific and other information. In order to facilitate this, a rather cumbersome but necessary structure was used in the BCLME EAF project (figure 5). EAF is still perceived by many to be essentially a scientific exercise and the debate is frequently dominated by scientific considerations. To avoid this, the institutional structure of the project was designed to ensure that societal goals and operational requirements of EAF were the guiding force, notwithstanding the essential role of scientific information and advice. The Steering Committee and regional workshops were intended to facilitate and maintain the regional perspective of the project and ensure good communication and coordination between the three countries. The national task groups in each country ensure participation by and guidance from the range of stakeholder views, including managers, decision makers, fishing industry members and conservation groups, while the science and modelling groups have provided the crucial scientific advice and input to the process.

Figure 5
The institutional structure used in the EAF project to ensure interaction between policymakers, stakeholders and scientific advisors and coordination at the regional level



C. SCOPE OF THE PROJECT

Within the context of an ecosystem approach, it would have been desirable to include all fisheries in the Benguela ecosystem in the project, which would have allowed all the ecological and technical interactions between the different fisheries to have been taken into account. However, this was not practical with the limited time and resources and it was therefore decided to focus on selected fisheries in each country. The fisheries that are being addressed in the project include the most important fisheries in each country and collectively should cover most of the major impacts of fishing on the ecosystem (table 1).

Table 1
Fisheries included in the EAF project

Angola	*Namibia*	*South Africa*
Small pelagics	Sardine purse seine fishery	Small pelagics purse seine
Demersal trawl fishery (finfish and deep-water shrimp)	Hake trawl and long-line fisheries	Hake fishery
Small-scale fishery using gillnets and beach seine nets	Horse mackerel mid-water trawl fisheries	West Coast rock lobster

D. TARGET RESOURCES-ORIENTED MANAGEMENT REVIEWS

The first important step in the project was to review a number of key fisheries in order to identify what the likely key ecosystem impacts would be if the standard single species management approaches would continue to be implemented. More specifically, the objective was to identify primary problems, issues and needs related to EAF in existing management strategies in consultation with stakeholders. The fisheries in each country that were addressed through this process are shown in table 2. The short list for Angola is potentially misleading as the demersal trawl fisheries of Angola target a diverse range of species with no one species dominating catches. The two reviews therefore addressed a substantial part of Angola's marine resources.

Table 2
Fisheries for which TROM reviews were undertaken

Angola	*Namibia*	*South Africa*
Demersal trawl fishery (finfish and deepwater shrimps)	Hakes (*Merluccius paradoxus*): demersal trawl and long-line	Hake (*M. paradoxus* and *M. capensis*): trawl and long-line fisheries
Small pelagic fisheries (*Sardinella*) spp. and (*Sardinops sagax*)	Horse mackerel (*Trachurus trachurus capensis*): midwater trawl	Small pelagic (purse seine) fishery (inclusive of anchovy (*Engraulis capensis*) and sardine (*Sardinops sagax*)
	Horse mackerel (*Trachurus trachurus capensis*): purse seine	Squid (Jig) fishery for *Loligo vulgaris reynaudii*
	Sardine (*Sardinops sagax*): purse seine	West Coast rock lobster (*Jasus lalandii*) fishery: inshore shallow-water trap fishery
	Rock lobster (*Jasus lalandii*)	South Coast rock lobster (*Palinurus gilchristi*) fishery: offshore deep-water trap fishery
	Deep sea crab	Abalone (*Haliotus midae*) fishery: diving
	Seals	Mid-water trawl fishery for horse mackerel (*Trachurus trachurus capensis*)
		Traditional linefish (coastal shore and sea-based multispecies)
		Kwazulu Natal prawn fishery: offshore trawl
		Large pelagics: offshore long-line and pole fisheries for albacore and other tunas as well as shark

In accordance with the FAO Guidelines (FAO, 2003) for stated or de facto objectives for the fishery, four major considerations were taken into account in the reviews:

(a) The fishery should be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity;

(b) Management of the fishery should include the determination of ecosystem factors relevant to the geographical scale and life history strategy of the target species;

(c) The nature and distribution of habitats relevant to the fishing operations should be identified, as well as an understanding of the impacts of the fishery on non-target species;

(d) The position and importance of the target species within the food web and the potential for the ecosystem to recover from fishery related impacts should be known.

Possible impacts of each sector that were considered included:

(a) Effectiveness of the current management measures in relation to the fishery itself, including their effectiveness in ensuring sustainable utilization;

(b) Associated impacts, including significance and risk of each impact on the ecosystem structure and/or function, on habitats or on the populations of associated species and on associated biological diversity and productivity;

(c) Problems being experienced in the fishery with respect to compliance and monitoring, and any complaints or dissatisfaction among fishers and rights holders;

(d) Details of direct interactions with other fisheries, for example, competing for the same target species, target species taken as by-catch in another fishery, and so forth;

(e) Information on the nature and extent of by-catch (capture of non-target species) and extent of discards (the proportion of the catch not landed) and unobserved fishing mortality (i.e., sources of mortality other than those mentioned above);

(f) The effects of supply and use of bait;

(g) Impacts on recognized protected, endangered or threatened species and management objectives in terms of impact identification and avoidance/reduction of these species;

(h) Details of direct interactions with the ecosystem (impact on sea bottom, pollution caused by fishery and effects of coastal zone development or land-based pollution);

(i) Physical impacts on habitat: gear and gear lost during fishing operations, for example, ghost fishing.

The TROM reviews were used as a basic source of information for the EAF process that followed.

E. EVALUATING THE FEASIBILITY OF THE ECOSYSTEM APPROACH TO FISHERIES

EAF is still a confusing topic for many and there is still much debate on what it is and what it entails. The simplest way to cut through this confusion in a given fishery or ecosystem is to start by examining the existing set of fisheries and the system being used to manage them, as well as external factors that could have an effect on the ecosystem. What needs to be considered

is where the current management system may be failing to prevent or adequately mitigate impacts that are affecting other stakeholders, fishery and others, or that may threaten the long-term sustainability and productivity of the ecosystem. This was the first step in this project and the process that was followed in identifying the needs and management options for EAF in the Benguela ecosystem can be summarized as follows:

(a) Scoping exercise which was done through the TROM reviews;

(b) Identification of all issues of concern in the fisheries considered, within the scope of EAF, that were not being satisfactorily addressed under the existing management strategy and system;

(c) Prioritization of the issues identified under point (b);

(d) Preparation of performance reports, outlining an appropriate management response, for each issue of moderate or higher priority;

(e) Benefit-cost analyses for the issues considered to arise and require action as a result of adoption of EAF. These analyses consisted of:

(i) Identifying the broad objectives for the fishery against which costs and benefits needed to be evaluated;

(ii) Grouping the EAF issues according to theme and possible management actions;

(iii) Performing preliminary evaluations, based on expert opinion, of the benefits and costs of suitable management responses;

(f) Amalgamation and refinement of performance reports to produce a single performance report for each group of issues;

(g) Preparation of reports for submission to management agencies on potential approaches to implementation of EAF and preliminary evaluation of appropriate management actions and their benefits and costs in relation to the goals and objectives for the fishery.

This is little different, in essence, from the standard process that should be followed in conventional fisheries management and which is currently applied, albeit in different guise, in the BCLME countries for at least some of the fisheries (e.g., management procedures for small-pelagics in South Africa (De Oliveira and others, 1998). There is therefore nothing fundamentally new in the process of moving from identification of priority issues to implementation of EAF. What will be new under EAF is that many more issues than are usually considered in traditional, single-species management will have to be addressed, and these are likely to highlight more conflicts than are commonly recognized in conventional management.

F. SCOPING EXERCISE

For each fishery, a preliminary scoping exercise was undertaken to identify and synthesize the information available on the fishery and the resources on which it depends. The TROM reviews were the reports generated from the scoping exercises undertaken across the fisheries included in the project in each of the three countries.

G. IDENTIFICATION AND PRIORITIZATION OF ISSUES AND MANAGEMENT RESPONSES

After the scoping exercise, it is necessary to identify and prioritize the problems, or issues, related to implementation of an ecosystem approach in each fishery. Any factor which is a cause for concern under the prevailing management regime is considered to be an issue. The approach used to identify and prioritize issues followed that developed within Australia as a tool in the attempts there to implement "ecologically sustainable development" across a number of Australian Federal fisheries (Fletcher and others, 2002). That approach includes the following tools and steps.

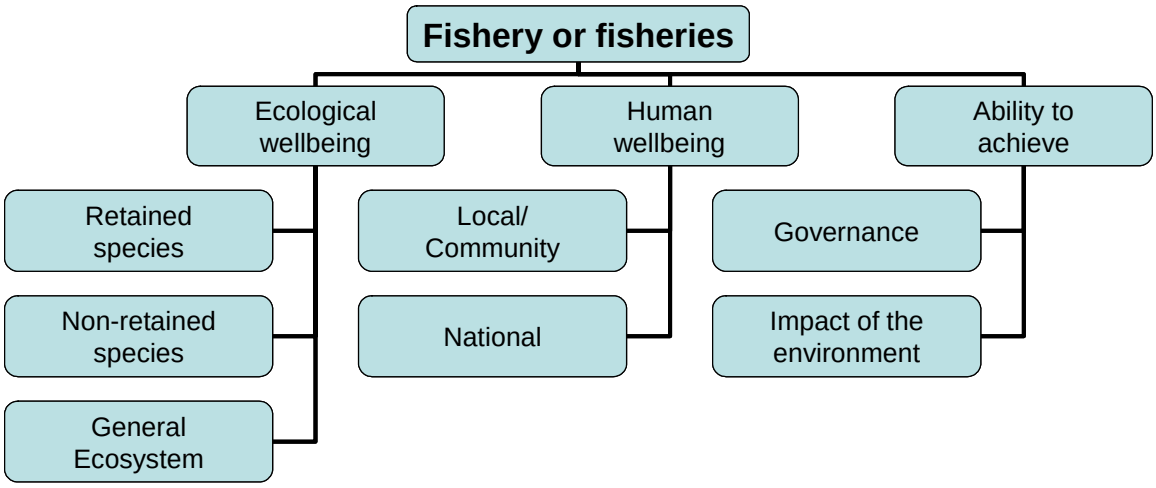
(a) A conceptual framework (figure 6) and guidelines to facilitate the identification of issues in a particular fishery or ecosystem;

(b) A versatile and informative means of prioritizing the identified issues on the basis of estimated or perceived risk. Risk is estimated as the product of the ordinal scores of: the likelihood of the feared outcome from a particular issue occurring under the existing management strategy (e.g., the likelihood of current fishing leading to a serious decline in the abundance of a particular by-catch species); and the magnitude of the consequences of that outcome in terms of the goals of ecosystem management;

(c) A template for a Performance Report which describes the best management response to reduce or eliminate the risk associated with a particular issue. The description of the response includes operational objective, indicators and reference points and future management actions (table 3).

The approach developed by Fletcher and others, (2002) was considered by FAO to be a useful means of operationalizing EAF and was described in the *FAO Technical Guidelines* on the ecosystem approach to fisheries management (FAO, 2003) as a valuable tool.

Figure 6
The basic hierarchical tree used to guide deliberations on the issues of concern in the fishery or ecosystem under consideration (after Fletcher and others, 2002). Additional trees developed by those authors break down the boxes under each of the three second-level headings (Ecological well-being, etc.) into more and more detail to assist users to think broadly across all possible issues that could apply in the fishery or ecosystem under consideration.



The ecologically sustainable development approach was implemented in this project in the form of a series of workshops, one for each fishery, that have been designated as Risk Assessment for Sustainable Fisheries workshops. The workshops were intended to be participatory and to include representatives from the range of managers, science and information advisors and stakeholders, including representatives of fishery subsectors and conservation groups. Responses from stakeholders varied with good representation in a number of workshops, particularly in South Africa, but disappointing in some other cases. Ensuring good stakeholder representation will be very important as the process is taken further across the region.

Table 3

The structure of a Performance Report used in the BCLME programme to describe the potential management response to a particular EAF issue or group of issues where a number of issues could be addressed by a common management response (after Fletcher and others, 2002)

	Report heading
1.	Issue or issues being addressed
2.	Objectives (a) Operational objectives; (b) Subsidiary objectives (where appropriate).
3.	Indicators and robustness
4.	Reference points
5.	Data requirements/availability
6.	Fisheries management response (a) Current; (b) Future.
7.	Future research
8.	Comments and action
9.	External drivers

The risk assessment workshops generated three major results: a list of issues of concern for each fishery, the estimated risk associated with each issue, and preliminary Performance Reports that proposed potential management responses to address the higher priority issues.

H. BENEFIT-COST ANALYSES AND AGGREGATED PERFORMANCE REPORTS

Effective implementation of EAF will result in benefits, which may be ecological, economic, social or some combination of those three, but will frequently also invoke additional costs across the same dimensions. If EAF is to be accepted and sustained, it is essential that in the planning and implementation phases, decision-makers and all stakeholders are well aware of the benefits and costs that will result from different options. The next step in the process was therefore to estimate the benefits and costs of the management actions proposed in the preliminary Performance Reports. In practice, they should be estimated using the best available information, which will often include stakeholder knowledge. In this feasibility study, with the wide range of issues and management actions being considered, it was not possible to investigate the benefits and costs thoroughly and rigorously. Instead, the project generated preliminary estimates based largely on expert opinion. This was done through a series of dedicated workshops, one for each fishery. As with the risk assessment workshops, these were intended to

include good stakeholder representation but, again, this varied from case to case. The tasks of each workshop were as follows:

(a) Starting with results of the risk assessment workshops, to identify the issues and the operational objectives associated with them that could be considered to arise from the implementation of EAF (as opposed to those issues that would be addressed under conventional management). These issues are referred to as the "EAF issues". It was recognized that some EAF issues are already being addressed in all three countries. In such cases, the evaluation of costs and benefits would be for any actions necessary to improve or strengthen the current approaches. If no additional action was required, the issues should either not arise or be given a low priority in the risk assessment workshops;

(b) To aggregate and summarize the full set of objectives for each fishery, as contained in the existing policy goals and including any new goals or objectives recommended from the risk assessment workshops, into not more than 10 broad objectives. The benefits and costs of each management action were estimated against these broad objectives. This aggregation of objectives was considered necessary to avoid the overwhelming task, and amount of information generated, of attempting to estimate benefits and costs across the large number of operational objectives that had been developed to address all medium and high priority issues;

(c) Also as a necessary simplification, to group issues according to their broad theme and on the basis of whether they could be addressed by similar management responses;

(d) To prepare aggregated performance reports for each group of issues by reviewing and supplementing, where necessary, the management measures and rules that had been identified for the EAF issues in the preliminary Performance Reports and amalgamating them into a common performance report;

(e) Using the best information available, given the time and personnel constraints, to evaluate the expected benefits and costs of those management measures or rules in relation to the broad objectives. Benefits and costs were estimated for both the short term, which was defined as up to three years, and the long term which was defined as 5 to 10 years.

I. IMPLEMENTATION

The project is intended to evaluate the feasibility of implementation of EAF and does not include implementation itself. The implementation process that may follow should include three consolidated tasks: reconciling the objectives and measures, followed by implementation of the agreed measures and periodic review of progress.

J. RECONCILING THE OBJECTIVES AND MEASURES

The intention of EAF is to ensure that all uses of and impacts on an ecosystem are collectively sustainable and, under ideal circumstances, result in optimal use of the products and services from that ecosystem. Direct and indirect interactions within an ecosystem mean that individual issues cannot be addressed independently, as attempts to manage any one issue are

likely to have impacts, positive or negative, on other issues. The management plan and strategy for any fishery and ecosystem must therefore simultaneously address all objectives, as far as practical. The different objectives will usually not be fully compatible and there will be conflicts between them, which will be reflected in the costs and benefits of management actions already in place and those being considered for implementation of EAF. These conflicts need to be reconciled, which will frequently require trade-offs between the priority given to different objectives and, in some cases, entire objectives may be found to be unattainable when combined with other higher priority objectives and will have to be abandoned. The benefit-cost analyses are intended to provide decision makers with information on how the different objectives will be impacted by given management actions. This is essential information for the proactive and objective-driven fisheries management that is required for implementation of EAF. Failure to reconcile objectives in the planning will lead to conflicts in implementation with attendant management problems and costs that may affect a number of different goals and objectives.

The provision of information does not solve the problem and ultimately the decision makers and stakeholders will have to decide on the exact form of the final set of objectives and the management actions required to achieve those objectives. This should be done with ongoing, iterative provision of scientific advice and the process can be facilitated by using suitable tools and aids for decision-making. The benefits and costs of EAF will frequently be substantive and will also frequently be inequitable, with costs being required from some users in order to provide sustainable benefits for others, including the societal benefit of halting unsustainable use. Agreeing on objectives and management actions is therefore unlikely to be a quick and easy process in EAF and a pragmatic, step-by-step approach, implemented over years rather than months, may often be required until the full goal of EAF is achieved.

K. IMPLEMENTATION AND REVIEW

Once the objectives and management actions have been agreed upon, they need to be implemented, with suitable enforcement to complement voluntary compliance, and the performance of the fishery monitored and periodically reviewed. Adjustments should be made to the management actions where found to be necessary in the review. The indicators and reference points identified in the Performance Reports will be central to this process. It needs to be recognized that uncertainties in all the information can lead to suboptimal decisions being made and that the ecosystem is likely to change with time. Failure to achieve objectives therefore needs to be identified early and appropriate management responses made to avoid serious and long-lasting damage to the ecosystem and the goods and services it can provide.

L. USE OF THE BEST AVAILABLE SCIENTIFIC INFORMATION

One of the common arguments against the implementation of EAF is the need for increased information. Lack of information will undoubtedly hinder progress towards EAF but, as with conventional fisheries management and natural resource use in general, the precautionary approach advises that lack of certainty should not be used as a justification for not taking appropriate action. The key principle is the use of the best scientific information available and appropriate use of precaution in the face of uncertainty (FAO, 1995).

This project set out to make use of the best information available and it was hoped that the Science and Modelling Groups would be able to supplement existing information through undertaking new analyses to evaluate, for example, risks, the feasibility and impacts of changes to management measures, and some of the costs and benefits. As a result of heavy commitments by all scientific staff participating in the project, this has, to a large extent, not been possible. As a result, most of the results generated by the project are based on existing scientific results which commonly have had to be interpreted to provide the particular information required, and on expert opinion from all participants. This information unquestionably has at least indicative value and the results and conclusions are considered to be qualitatively valid and accurate, but not necessarily quantitatively so.

As the three countries move forward in implementation of EAF, it will be necessary to revisit results and conclusions that would benefit from precise quantitative information, such as estimated future total allowable catches, or the risk of overfishing on retained and non-retained species. Where improved information can be provided in a timely and cost-effective manner it should be generated and used to improve the information obtained in this feasibility study.

M. RESULTS TO DATE: EAF ISSUES AND MANAGEMENT RESPONSES IN THE BENGUELA CURRENT LARGE MARINE ECOSYSTEM

Issues and priorities

The risk assessment workshops held in the three countries identified a large number of issues relevant to an ecosystem approach that were considered to be inadequately addressed under the prevailing management in the various fisheries (BCLME, 2006a). Many of the issues were applicable within a conventional approach alone and were not only a consequence of consideration of EAF. The full lists of issues are provided in the reports of the workshops (ibid.). The list of EAF issues and risk values from the South African hake fishery is shown in table 4 as an example of the results obtained in all the workshops. A total of 96 issues were identified for this fishery, of which the 58 listed in table 4 were considered to be EAF issues. Of the 58 EAF issues, 10 were categorized as "retained species" issues, 14 as non-retained species, 10 as general ecosystem issues, 1 as a community issue and 23 as governance issues. Three were considered to be of extreme priority, 14 of high priority, 22 of medium priority and 19 were of low priority. The extreme issues included the lack of suitable baseline information on the social and economic aspects of the fishery as well as inadequate management and research capacity in the management agency.

In the case of Angola, examples of high priority issues include the impacts of the banda-banda fishery (small-scale fishery utilizing a fine-meshed beach seine of 10 to 12mm mesh size (Tchikulupiti, 2005)) on the sustainability of exploited pelagic species. This fishery exploits juveniles of many species, including those of key pelagic species such as horse mackerel and sardinellas. Challenges faced by the demersal fishery were considered to be mainly related to the multispecific nature of that fishery and the need to develop suitable indicators. A high risk was also perceived for the possible impacts of bottom trawls on epibenthic organisms. In the small-scale fisheries (gillnets), ghost fishing and incidental capture of vulnerable species (e.g., sharks and sea turtles) were considered as high risk environmental issues, while lack of infrastructure

and of organization of the sector (e.g., through cooperatives) were recognized as key issues affecting the development of the sector.

Allocation of fishing rights, collection of reliable fishery data, inadequate monitoring and control systems and the lack of effective management plans for all the species exploited were all considered as major governance issues in the fisheries of Angola considered in this workshop. Management plans are in place but their effectiveness in rebuilding the stocks is still unclear. In all cases, oil exploration and exploitation activities, including the resulting oil spills and pollution, were considered as important threats to the resources and the environment and the communities depending on these. The fishery sector also seems to be threatened by a number of social issues such as the increased use of alcohol and drugs by fishermen, with both health consequences and negative impacts on safety at sea. Lack of infrastructure and high oil prices were seen as major threats to sector development.

For the Namibian fisheries examined, a central issue was considered to be the lack of reconciled and approved management plans. Thirteen issues, mainly within the "Governance" component, received an "Extreme" risk rating for the hake fishery. Also within the hake fishery, two issues from the "Ecological well-being" category were considered to be of "Extreme" risk: the by-catch (or incidental mortality) of threatened seabirds in both long-line and trawl operations; and the potential impact of the by-catch of monkfish within the hake fishery on the sustainability of the monkfish fishery. Under the heading of "Human well-being", the close link between the living standards of the fishing community and fishery service providers and the state of the fishery and of the stock were identified as issues that required careful management consideration. High levels of unskilled labour and lack of training and development opportunities within industry structures were also considered to need attention. International economic factors such as fuel prices and exchange rates as well as local health issues such as HIV and AIDS were among the extreme risk "External impacts" that could hinder the fishery attaining its objectives.

In the mid-water trawl fishery, it was concluded that little was known about the trophic position of horse mackerel in the ecosystem and the dependence of certain predators on it. Furthermore, the impact of this fishery on several by-catch species has not been quantified; not least, several species of sharks and seabirds that have a threatened conservation status. A very specific management issue that was considered to need attention is the justification for the regulation prohibiting trawling within the 200m depth contour.

The most striking feature of the purse seine fishery was the apparent low abundance and variability in the biomass of the target species, sardine, and the implications of this for the total allowable catch of the species. This should also be seen in light of the need to rebuild the stock. Another significant feature of this fishery was considered to be the keystone trophic position occupied by the target species which has led to changes in conservation status of dependent species as well as possible long-term changes in the trophic structure of the ecosystem. This fishery was previously the largest employer in the fisheries sector, and the current depressed state of the stock is leading to significant socio-economic hardships.

In the case of South Africa, high-priority ecological issues were identified in the hake fishery, including the implications of fishing on the size structure of the *M. capensis* stock and the possible effects of trawling on benthic habitat and biota. For the small pelagic fishery, the potential impacts of removing forage fish eaten by predators and uncertainty around decadal-scale fluctuations were considered to be issues of high priority. In the West Coast rock lobster fishery, issues relating to human well-being, especially those relating to small operators, were generally considered to be of higher priority than human and ecosystem well-being issues.

Table 4

An example of the EAF issues identified in the RASF workshops: the South African hake fishery

The column ”Objective” refers to the broad objectives identified for the fishery, “Type” indicates whether the issue was an EAF issue or a target-resource only (TROM) issue while ”ID” provides a cross-reference number to the full list of issues.

Objective	*Type*	*Category*	*Sub-category*	*ID*	*Issue*	*Cons.*	*Like.*	*Risk*	*Cat.*
1. Fund further EAF research and model dynamics									
1	EAF	Eco. well-being	Retained spp.	3	Both hake spp.: uncertainty about the estimation of natural mortality (predation and cannibalism)	3	6	18	H
4	EAF	Ability to achieve	Governance	78	Currently biodiversity audits for marine species are not being done	2	6	12	M
4	EAF	Gen. ecosystem		34	Removal of predators may have an effect on the abundance of smaller pelagic species and mesopelagics	4	3	12	M
4	EAF	Gen. ecosystem		33	Trophic effects of removing a proportion of a high level predator, with no obvious replacement species	4	3	12	M
4	EAF	Eco. well-being	Non-retained	24	Mortality *of Galeorhinus* and *Mustelus* in the inshore trawl fishery (both commercially harvested)	2	6	12	M
4	EAF	Gen. ecosystem		35	Change in size structure of hake leads to a switch in prey preference	3	3	9	M
1	EAF	Gen. ecosystem		37	Hake are a component of the diet of marine mammals and other top predators (seals, swordfish – possible snoek)	1	6	6	L
4	EAF	Eco. well-being	Non-retained	23	Mortality of *Galeorhinus* and *Mustelus* in the long-line fishery (both commercially harvested).	1	6	6	L
4	EAF	Eco. well-being	Retained spp.	17	Lack of understanding and quantification of the impact on linefish (kob, white stumpnose, etc.)	1	6	6	L
4	EAF	Gen. ecosystem		42	Disturbance of sediments may change water chemistry (oxygen, etc).	0	5	0	N
2. Enforce responsible fishing practices									
2.1. Enforce appropriate permit conditions to minimize seabird mortality									
2	EAF	Eco. well-being	Non-retained	21	Threatened species of seabirds (also protected) caught/ injured/killed by trawling	3	6	18	H
2	EAF	Gen. ecosystem		39	Distribution patterns and behaviour of seabirds are being affected by the availability of offal	2	6	12	M
2	EAF	Eco. well-being	Non-retained	20	Threatened species of seabirds (also protected) caught/ injured/killed in long-line operations	2	6	12	M
2	EAF	Eco. well-being	Non-retained	22	There is directed catch of seabirds in the handline fishery	1	5	5	L
2	EAF	Eco. well-being	Non-retained	32	Potential soaking of gannets from fish meal factory vessels	1	2	2	L

Abbreviations: Cons.=consequence; Like.=likelihood; Cat.=risk category (no risk, low, medium, high or extreme); Gen.=general; Eco.=ecosystem; spp.=species; MCM=Marine and Coastal Management which is the national agency responsible for fisheries research and management.

2.2. Enforce appropriate permit conditions to manage by catch utilization									
2	EAF	Eco. well-being	Non-retained	27	Bycatch of “protected” linefish on soft ground available to the inshore trawling – silver kob, dusky kob, etc.	3	6	18	H
2	EAF	Eco. well-being	Retained spp.	15	Monk, kingklip stocks are overexploited	4	4	16	H
2	EAF	Eco. well-being	Retained spp.	18	Impact on other commercial species (skates, rays, gurnards, sharks, jacopever, john dory, angel fish, bellman, chokka, etc.)	3	3	9	M
2	EAF	Eco. well-being	Non-retained	26	Bycatch of wreckfish	3	3	9	M
2	EAF	Eco. well-being	Retained spp.	16	Snoek stock is being impacted	2	4	8	M
2	EAF	Eco. well-being	Non-retained	29	Bycatch of other benthic species that have been recorded in the trawl catch	1	6	6	L
2	EAF	Eco. well-being	Non-retained	28	Bycatch of “protected” linefish on hard ground	2	1	2	L
2.3. Enforce appropriate permit conditions to minimize shark mortality									
2	EAF	Eco. well-being	Retained spp.	18	Impact on other commercial species (skates, rays, gurnards, sharks, etc.)	2	6	12	M
2	EAF	Eco. well-being	Non-retained	30	Bycatch of other sharks, rays and skates (not threatened but not assessed) are caught	2	6	12	M
2	EAF	Eco. well-being	Non-retained	25	Mortality of all other threatened sharks in long-line and trawl.	2	6	12	M
2.4. Enforce appropriate permit conditions to minimize impact on seal population									
2	EAF	Gen. ecosystem		40	Seals benefit from offal discards	1	6	6	L
2	EAF	Eco. well-being	Non-retained	19	Seals (protected sp) are killed in trawling operations	1	6	6	L
2	EAF	Eco. well-being	Non-retained	31	Shooting of seals interacting with gear	0	6	0	N
2.5. Enforce appropriate permit conditions to minimize impact on benthic substrate									
2	EAF	Gen. ecosystem		38	Impact of trawls on the benthic habitat and biota	3	6	18	H
2	EAF	Gen. ecosystem		36	Ghost fishing by net fragments	1	2	2	L
2	EAF	Gen. ecosystem		41	General pollution associated with fishing vessels and harbour activity			0	N
3. Maintain socio-economic well-being through management measures									
3.1. Rebuild hake stock									
3	EAF	Eco. well-being	Retained spp.	2	Both hake spp.: fishing mortality is underestimated owing to discarding and survival after escapement	3	6	18	H
3	EAF	Eco. well-being	Retained spp.	5	Both hake spp.: uncertainty about variability in recruitment	3	6	18	H
3.2. Develop economic parameters									
3	EAF	Human well-being	Community	44	There is a lack of baseline socio-economic information	5	6	30	E
3.3. Mitigate negative social impacts									
4. Maximize sustainable yield by monitoring biological trends									
5. Ensure MCM institutional structures are in place and effective									
5.1. MCM institutional structures									
5.1.1. Improve enforcement of compliance									
5	EAF	Ability to achieve	Governance	59	Inspector coverage is inadequate and possibly biased geographically and by sector	2	6	12	M
5	EAF	Ability to achieve	Governance	58	Inadequate enforcement – coverage is low	3	3	9	M

5.1.2. Improve resource management capacity									
5	EAF	Ability to achieve	Governance	68	Lack of management and institutional knowledge	4	6	24	E
5	EAF	Ability to achieve	Governance	60	There is no Resource Management working group	3	6	18	H
5	EAF	Ability to achieve	Governance	85	The requirements for eco-labelling are putting heavy demands on the management agency	2	6	12	M
5	EAF	Ability to achieve	Governance	79	No institutional reviews of research and management	1	6	6	L
5.1.3. Improve research efficacy									
5	EAF	Ability to achieve	Governance	67	Inadequate research capacity and institutional knowledge	4	6	24	E
5	EAF	Ability to achieve	Governance	62	Catch data are not available for real-time response	3	6	18	H
5	EAF	Ability to achieve	Governance	63	Observer data have not been properly analysed or reconciled with catch records	3	6	18	H
5	EAF	Ability to achieve	Governance	69	Inadequate coordination of research (nationally, regionally and internationally)	3	6	18	H
5	EAF	Ability to achieve	Governance	64	Problems with the validity of scientific observer data in portraying the real picture	2	6	12	M
5	EAF	Ability to achieve	Governance	79	No institutional reviews of research and management	1	6	6	L
5.2. Improve consultative mechanisms									
5.2.1. Coordination with fishing industry bodies									
5	EAF	Ability to achieve	Governance	61	There are no formal or informal lines of communication with industry bodies and other stakeholders	3	6	18	H
5	EAF	Ability to achieve	Governance	57	Conflict between sector users	2	6	12	M
5	EAF	Ability to achieve	Governance	83	Industry has not shown much interest in some broader management issues but focuses on direct issues	1	6	6	L
5.2.2. Formalize and improve communication with other stakeholders									
5	EAF	Ability to achieve	Governance	86	NGOs not involved in management and scientific working groups	3	6	18	H
5	EAF	Ability to achieve	Governance	70	Inadequate communication with other government departments – specifically with Mineral and Energy Affairs or Petroleum Agency	2	6	12	M
5	EAF	Ability to achieve	Governance	84	The fact that the long-line and hand-line industries are not certified for eco-labelling hampers the certification of the trawl fishery	2	6	12	M
5	EAF	Ability to achieve	Governance	71	Inadequate coordination with national ports authority with regard to facilities and services for fishing vessels	2	5	10	M
5	EAF	Ability to achieve	Governance	77	There is no formal peer-review of management plans	1	6	6	L
5	EAF	Ability to achieve	Governance	82	Criteria for representation on working groups should be reviewed. Difficulties in weighting representation	1	6	6	L
5.3. Improved legal and policy framework									
5.3.1. Develop and implement legal and policy actions									
5	EAF	Eco. well-being	Retained spp.	8	*Merluccius paradoxus*: stocks are shared between Namibia and South Africa	3	6	18	H
5	EAF	Eco. well-being	Retained spp.	10	*M. Capensis*: stocks are shared with Namibia	3	3	9	M
5	EAF	Ability to achieve	Governance	75	The national Act needs to be revised after consultation	1	4	4	L

N. PERFORMANCE REPORTS

The risk values (likelihood multiplied by consequence) estimated for all the issues were ranked and classified on a scale from negligible to extreme according to the value in each case (see Fletcher and others, 2002, for details). Preliminary performance reports were developed at the risk assessment workshops for issues with an estimated risk value of moderate or higher.

The large number of issues identified in most of the fisheries considered in a large number of performance reports and therefore also a large number of independent management measures. This is likely to be a common outcome for fisheries and ecosystems wherever management is still dominated by conventional approaches. In theory, each management response could and often should be developed independently as the optimal means of addressing a given issue and then all the management measures for all the issues reconciled in order to arrive at an optimum strategy for the fishery or ecosystem as a whole. In practice, this will be logistically and scientifically very difficult.

For the purposes of this study, therefore, the scope of the problem of reconciliation was simplified. The first step was to identify and separate the "EAF issues" from the conventional issues, as described in the methods for the cost-benefit analyses. This was consistent with the central objective of the study, which was to evaluate the feasibility of implementing EAF in the region. Considering only the EAF issues reduced the number that had to be considered substantially. For example, the total number of issues in the Namibian mid-water trawl fishery was 54, of which 13 were considered to be EAF issues. Of course, the other issues are also important, as indicated by their risk values, and would still need to be addressed. The full list of issues and risk values will be supplied to the management agencies for their consideration.

The second step was to group issues according to their broad theme and on the basis of whether they could be addressed by similar management responses. Each group was then treated collectively. The preliminary performance reports developed for each independent issue in a group were amalgamated and modified as necessary to prepare a combined performance report for each group of issues. This step, while potentially losing detail, reduced the task to a manageable scale. For example, in the case of the South African hake fishery, a total of 96 issues were identified in the risk assessment workshop (BCLME, 2006a). Of these, 58 were considered to be EAF issues and these were grouped into the following eight categories at the benefit-cost workshop on the South African hake fishery (T. Fair-weather, D. Japp and L. Shannon, pers. comm.):

(a) EAF research and model dynamics;

(b) Responsible fishing (including impacts on non-retained species);

(c) By-catch of commercial species;

(d) Socio-economic considerations;

(e) Hake management issues (going beyond those currently considered in the existing management strategy);

(f) Compliance and management issues;

(g) Research capacity issues;

(h) Policy issues.

In most cases where implementation of EAF is being planned, there is likely to be a need to reduce the complexity of the problem, reflected in the number of issues, to a manageable scale and it will be important to find an appropriate balance in each case between practicality and ensuring that important detail and considerations are not lost by the amalgamation.

The performance reports for each group of issues are, at this stage, still advisory documents, potentially providing information to assist decision makers to identify and set the management measures necessary for an EAF management strategy. The reports therefore did not necessarily specify a particular measure or set of measures but considered different options to address the issues, each of which would have unique advantages and disadvantages or benefits and costs. The management measures proposed within the project are still broad and generalized because of time constraints and the magnitude of the task. For example, the management measures proposed to address the group of issues under the heading "by-catch of commercial species" were: (i) where feasible, assess status of and develop management plans for targeted by-catch species; (ii) manage fishing effort; (iii) manage and monitor by-catches (includes coordinating with line-fish management); and (iv) investigate (and implement) zoning of sector specific fishing areas. The management measures considered for "compliance and management issues" were: (i) develop capacity for Resource Management, to include both training and appointment of new staff (Resource Management is one branch within Marine and Coastal Management, the national management agency); (ii) establish effective communication between stakeholders (e.g., through a Resource Management working group); and (iii) enhance compliance by improving and increasing the capacity of fishery control officers.

At the time of writing, advisory performance reports had been prepared for all of the South African and Namibian fisheries and are being finalized for the Angolan fisheries. It will be necessary, if this work is taken further by any of the national management agencies or the Benguela Current Commission, to translate the broad measures into clearly and precisely specified measures, for example specifying the exact size and location of suitable closed areas or the precise reduction in effort required and in which fishing sectors. As discussed in section L above on use of the best scientific information available, this will require more detailed scientific analysis than has been possible during the present study and, as was attempted in this study, should also be carried out in consultation with the stakeholders.

O. BENEFIT-COST ANALYSES

Establishing the broad objectives

The purpose of EAF is to recognize and take into account the full range of objectives being pursued and sought within a given fishery or ecosystem, without compromising the overarching objective of sustainable use. In evaluating the desirability and usefulness of different management measures for a fishery, the implications of the measure need to be considered in terms of those objectives. There is a large number of objectives across the different stakeholders and interest groups for each fishery and many of them cannot be simultaneously met. This is evident from the large number of issues identified for the different fisheries, as behind each issue is an underlying objective. Ideally, all of these objectives should be explicitly considered and the optimal trade-off between them identified and pursued. Computationally and psychologically this would almost certainly be impossible when one is dealing with numbers in multiples of 10 and, again, simplification was considered necessary. In order to achieve this, broad objectives were identified for each fishery, based on the original policy goals and the issues identified in the risk assessment workshop. In practice, this led to a reversion back to the policy goals but supplemented by any high priority issues that had been identified in the risk assessment workshops but had not been represented in the initial policy goals. Examples of broad objectives are included in table 5.

Table 5
Broad objectives identified for example fisheries in each country

Angola demersal trawl fishery	*Namibia hake fishery*	*South Africa demersal trawl fishery*
1. Restore biomass of commercially important demersal species to optimal levels of productivity.	Ensure sustainable exploitation of the hake stocks (rebuilding, optimize yield, maintain size structure, etc.).	Maximize long-term economic sustainability of the fishery (e.g., improve catch rates and size structure).
2. Maintain demersal fish community structure in terms of size structure and species composition.	Ensure sustainable exploitation of the other stocks (e.g., monkfish, sole, kingklip, etc.)	Manage hake stocks to ecologically sustainable levels (trophic interactions)
3. Reduce impacts of bottom trawl fishery on vulnerable species (sea turtles, sharks)	Maintain biodiversity	Rebuild hake stocks to minimize risk to the resource (recruitment, etc.)
4. Reduce impacts of bottom trawling on bottom substrate	Maintain ecosystem functioning	Minimize loss of biodiversity due to seabed damage
5. Promote development of the	Avoid environmental damage (habitats and	Minimize incidental mortality of seabirds,

artisanal fishery	substrate)	sharks, marine mammals, etc.
6. Promote the development and angolization of the industrial sector	Ensure optimum economic return to industry/country processing value added, etc.	Minimize discard and loss of target species and manage by-catch
7. Promote reliable supply of fish products to the population	Optimize social returns, employment, food security, empowerment, social upliftment	Develop appropriate management measures for multiple and or shared stocks
8. Contribution of the fishery to improvement of the local economic infrastructure and social base	Namibianization of the sector	Optimize socio-economic benefits across sectors
9. Ensure economic stability of the Angolan demersal fishing industry		Maintain adequate research and management capacity
10. Increase the contribution of the fishery to the national economy		

P. CONSIDERING THE BENEFITS AND COSTS OF MANAGEMENT MEASURES

The performance reports contain different options for management measures to address each group of issues. In order to establish an effective and acceptable management strategy, it is necessary to provide the decision makers with the best available information on the impacts, positive and negative, of each option, for the range of objectives underpinning the fishery. This will enable them, ideally in a fully transparent and participatory manner, to consider the trade-offs and arrive at a strategy that, in implementation, will come closest to achieving those objectives.

In the study, preliminary benefit-cost analyses were undertaken in multi-stakeholder workshops. The benefits and costs were based almost entirely on the collective wisdom of the participants in each workshop, which would generally have included scientists with knowledge of the best available scientific information. The workshop was asked to provide the consensus estimate of benefits and costs for each action against each broad objective on a scale of 0 to 4 where: 0 indicates negligible cost or benefit; 1 is a small but noticeable impact; 2 is a moderate impact; 3 a major improvement or will have major negative impact; and 4 an immediate and long-term impact or will be unsustainable from the outset. The assumption was made that the difference in value between each score is constant across the range of scores (i.e., they are

linearly related to actual impact). In addition it was assumed that the sum of zero costs (i.e., negligible) across all broad objectives would generate a total cost for the measure of 1 (i.e., small). This was based on the assumption that no benefit would be achieved without some cost. With those assumptions, benefit and costs ratios can be used for comparative purposes. The explicit assumption in the results presented in this study is that all broad objectives have the same policy weighting. In practice this is highly unlikely and it will be necessary in the future to consider the weighting of the different objectives and, again in a participatory manner, to try to reach agreement. This would best be done prior to and independently of decisions on specific management measures.

It is important to emphasize that, as with the performance reports, the benefit-cost analyses and the results that have been produced from them are preliminary only and that no focused scientific assessments (including the human sciences where appropriate) and validations were undertaken. Such improvements and checks will still need to be done, where feasible, before this advice can be considered sufficiently reliable and accurate for use by decision makers in setting management regulations. Nevertheless, the results obtained are still considered to be informative, providing guidance on the possible options for and obstacles to implementation of EAF. An example of the output from a benefit-cost analysis for a single management measure in the South African hake fishery is shown in table 6 and a summary of the costs and benefits of different management measures proposed to address the group of issues related to ”responsible fisheries” is shown in figure 7.

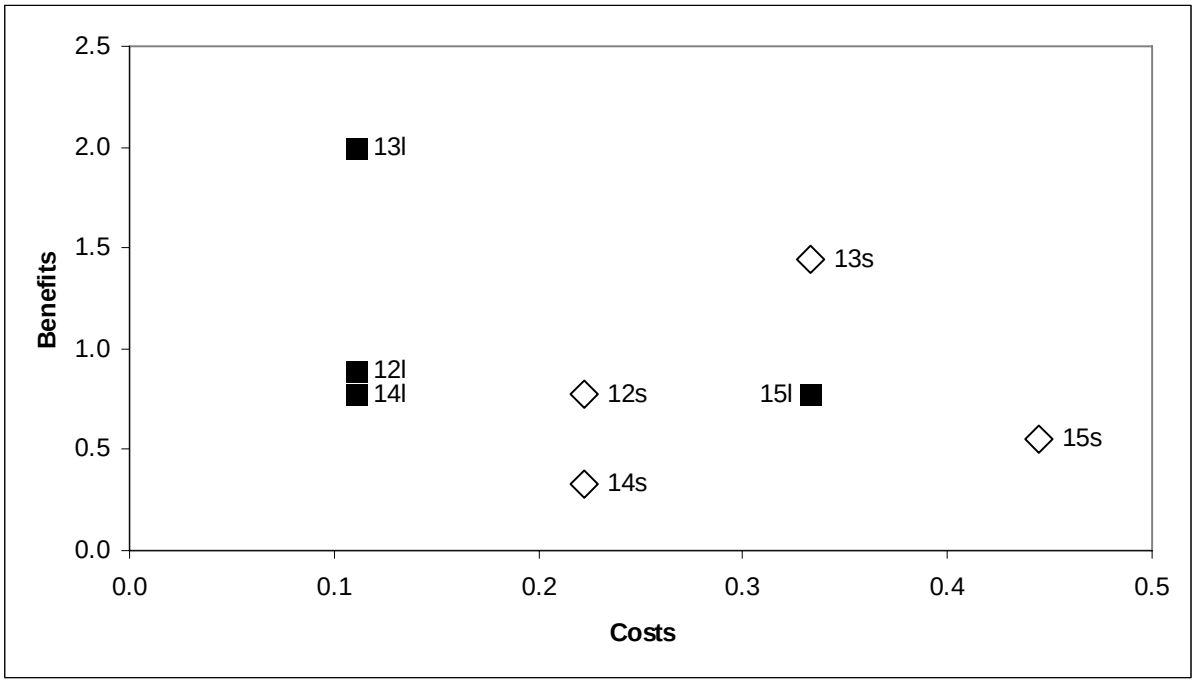
Figure 7 provides a comparative view of the average implications of the different options. Management measure 13 - controlling existing effort in the fishery in order to manage impacts on the retained by-catch species, instead of focusing only on the hakes as at present - stands out from the others as having the higher benefits in the short and long term. However, the short-term costs were considered to be higher than for measure 12 - developing individual management plans for each impacted species - and 14 - implementing supplementary by-catch limits. The long-term benefits for all four of the measures were considered to be greater than those in the short term while the costs were estimated to diminish in the long term. Before making a choice in practice, the decision-makers would need to look at the details of the costs and benefits for each objective (e.g., table 6) to identify where the costs and benefits would be felt most strongly. A final decision would be a policy choice and should take into account the weightings applied to each broad objective.

Table 6

An example, taken from the South African hake fishery, of the output from a benefit-cost analysis for higher priority EAF issues related to by-catch. The proposed management actions are different options which could be applied independently or in various combinations. The results, which are preliminary and based primarily on expert opinion, are shown here for only one of the possible management actions (Action 1: the development of species-oriented by-catch plans). See text for explanation of the scores.

	Management action			
Broad objectives for the fishery	*Where feasible, assess status of, and develop management plans, for "targeted" by-catch species*			
	Short-term		*Long- term*	
	Cost	*Benefit*	*Cost*	*Benefit*
Maximize long-term economic sustainability of the fishery (e.g., improve catch rates and size structure)	2	2	1	3
Manage hake stocks to ecologically sustainable levels (trophic interactions)	0	1	0	1
Rebuild hake stocks to minimize risk to the resource (recruitment, etc.)	0	0	0	0
Minimize loss of biodiversity owing to seabed damage	0	0	0	0
Minimize incidental mortality of seabirds, sharks, marine mammals, etc.	0	0	0	0
Minimize discard and loss of target species and manage by-catch	0	2	0	2
Develop appropriate management measures for multiple and or shared stocks	0	0	0	0
Optimize socio-economic benefits across sectors	0	1	0	1
Maintain adequate research and management capacity	0	1	0	1

Figure 7
A plot of the average benefits and costs across the nine broad objectives for the South African hake fishery for each of four management measures identified as potentially suitable to address the issues grouped under the heading "by-catch of commercial species". The label numbers refer to: 12 - where feasible, assess status of, and develop management plans, for "targeted" by-catch species; 13 - manage fishing effort; 14 - manage and monitor by-catches (includes coordinating with linefish management); and 15 – investigate and implement zoning of sector specific fishing areas. The letters following each number indicate whether the benefits and benefits are evaluated in the short term(s) or long term (l).



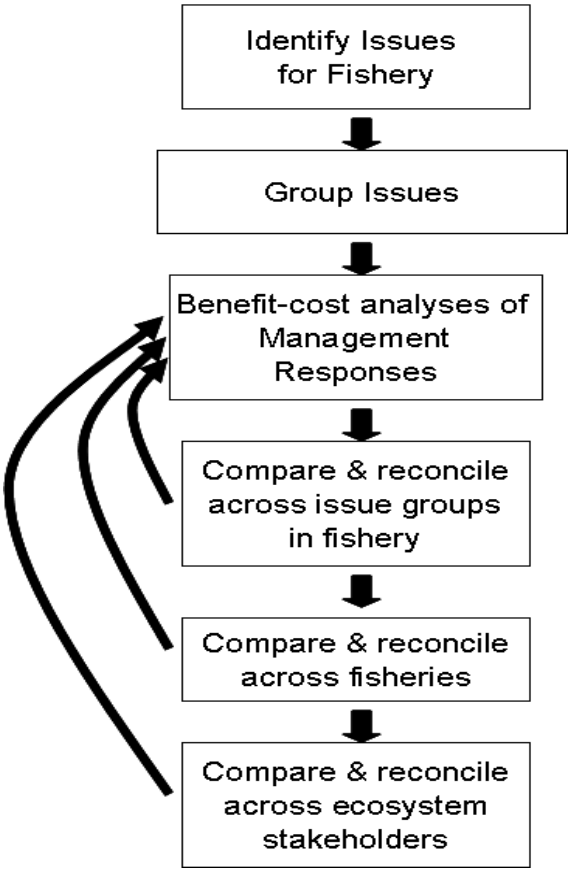
Q. INTEGRATING THE RESULTS ACROSS ISSUE GROUPINGS AND FISHERIES

As the field of view is expanded under EAF, inevitably the number of interactions increases and the disciplines of provision of scientific advice and of decision-making will need to iteratively narrow and broaden the fields of view in order to take into account the objectives at the level of individual priority issues and still reconcile them at the ecosystem level (figure 8). This will require comparing the management measures for each issue group and their costs and benefits across the different issue groups within each fishery and identifying conflicts and redundancies between the groups. The same will then need to be done between fisheries and, recognizing the need to integrate EAF within the broader field of integrated coastal and ocean management, across other users of the ecosystem as well. At each expansive step, it may be necessary to go back to the original management measures and consider adjustments, or total change, to address other issue groups and other users. For example, the proposed management of fishing effort in the South African hake fishery to reduce negative impacts on other

commercially-important retained species could be optimal for the by-catch group of issues but, hypothetically, may not address sufficiently the impacts on, for example, some low production shark species. It may also not take into account closed areas resulting from oil and gas exploration. When these considerations are taken into account, an alternative management measure, or more likely a combination of several management measures, may be found to be preferable.

There are no simple or recipe-book approaches to resolving the multicriteria and multidimensional features of EAF, integrated coastal management and integrated oceans management. The iterative approach here involves a breaking down of the problem into its smallest components and then rebuilding to a level of aggregation that enables the scientists, stakeholders and decision makers to wrestle with the complexity. There will be alternative methods and some of these may be found to be better but the experience gained in the project to date indicates that the approach followed in the project is undoubtedly informative, feasible and practical.

Figure 8
Scaling up and down the ecosystem and user groups



R. STAKEHOLDER INVOLVEMENT AND ECOSYSTEM APPROACH TO FISHERIES IN MANAGEMENT

From the beginning, the identification and prioritization of issues and the process for formulating an EAF management strategy is a mixture of science, again in its broader sense, and policy. What is considered an issue, the consequences of different issues, the objectives, and the estimated costs and benefits are heavily influenced by human choice. Involvement of stakeholders from the outset is therefore essential if the final EAF management plan is to be realistic, include the best available information and be likely to enjoy widespread support and credibility. The common misperception that EAF is mainly about and dependent on good science is turning the problem upside down. Science can help to inform and advise EAF: the better the science, the lower the level of precaution required (Cochrane, 1999) and the less the probability of being surprised by unexpected outcomes. Fundamentally, though, EAF is a product of and a requirement for human use.

The BCLME project has attempted to engage stakeholders from its outset as described earlier. It has been partially successful in doing this. It must be acknowledged that, probably because of their professional interests and responsibilities, the process has been dominated by natural scientists in all countries and the priorities, objectives and costs and benefits may therefore be biased towards the perspectives and priorities of natural science. Nevertheless, there has been participation by at least some members of the fishing industry, conservation groups and managers in the national risk assessment and benefit-cost workshops as well as the regional workshops. Good levels of participation, particularly by the fishing industry, took place in the South African national workshops and working groups and, as a consequence of this, proportionately greater confidence can be placed in the policy choices and values reflected in those results.

S. ECOSYSTEM APPROACH TO FISHERIES IN THE BENGUELA CURRENT LARGE MARINE ECOSYSTEM: THE FUTURE

As described in the introduction, the BCLME countries are familiar with the interactions between fisheries and the ecosystem and have a long history of research into these interactions. Management of fisheries in the region is also well established and generally of a high quality although a number of problems are being experienced at present as a result of different combinations of environmental influences and overfishing. The project has built on this expertise and knowledge. It has done so by bringing a formalized and structured process to considering the goals and objectives of an ecosystem approach and evaluating the weaknesses in the current management strategies and systems. In some cases, for example in the pelagic and demersal fishing sectors in South Africa and others, some issues that were identified in the TROM reviews have already been addressed by means of practical management measures. However, much remains to be done if sustainable use of the BCLME is to be assured for the long term. The project has explored, in a preliminary manner, broad approaches to address those weaknesses. In any follow-up to the project, which it is hoped will further progress towards implementation of EAF, it will be essential to build and improve upon the involvement of the stakeholders. This would almost certainly follow automatically from a clear intention by governments or the Benguela Current Commission to begin serious actions towards implementation of EAF.

The results of this project will be brought to the attention of the managers and decision makers in the national management agencies and to the Commission. The prioritized issues should give them good insight into the problems that need to be addressed and those that require greatest urgency. Follow-up action should include:

(a) Reviewing any uncertain or contested risk values and priorities using the best available information, including new investigation and analysis where necessary and attainable;

(b) For the moderate, high and extreme priority issues, re-examining the issue groupings and performance reports and, again with improved and updated information where relevant, refining those to ensure that they reflect the current state of knowledge and uncertainty and identify optimal and precisely specified management responses;

(c) Revising in the same manner the estimates of cost and benefits;

(d) Reconciling the proposed management responses across the different issue groups, fishery and ecosystem as outlined in figure 8;

(e) Using this information in a participatory and transparent manner to decide on the management responses to be implemented;

(f) Proceeding with implementation, followed by review in due course.

It is hoped that these steps will be followed as rapidly as the priorities require and that the second phase of the BCLME Programme will provide both impetus and resources to facilitate this. It is also hoped that that it will be recognized by the countries that the long-term economic benefits achieved through the implementation of management measures will outweigh the costs.

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VIII. ECOSYSTEM-BASED MANAGEMENT: FROM PRINCIPLES TO IMPLEMENTATION [14]

A. THE EUROPEAN UNION CONTEXT

In 2005 the European Commission proposed a Thematic Strategy for the Protection and Conservation of the Marine Environment, including proposals for binding legislation. On 7 June 2006, it adopted and put out for public consultation a Green Paper on a future Maritime Policy. The Green Paper is a consultative document. It is available in this room. And we shall be receiving and digesting comments on it throughout the next 12 months before we move forward with action proposals.

It is my intention today to share with you some thoughts on its potential relevance for EBM. I wish to emphasize that it does not yet represent European Union policy. In the conception of the Commission, the Marine Environment Strategy represents the environmental pillar of a future maritime policy.

The detailed assessment of the state of the marine environment which the Marine Strategy will provide will be particularly valuable to devising the frameworks through which all uses of the oceans can be regulated. Conversely the regulation of maritime activities on the basis of an integrated analysis will provide the means to achieve the aims of the Marine Strategy. The key aim is to achieve good status of the European marine environments by 2021.

The Marine Strategy introduces the principle of ecosystem-based spatial planning to be implemented at the regional level. Without this, we will soon be unable to manage the increasing, and conflicting, uses of the oceans.

The ecosystem-based approach: principles and problems

If we are to succeed in implementing the ecosystem-based approach we would do well to keep the presentation of the concept simple. This is imperative in order to both explain it to our citizens and gain the necessary political and public support. We define it as: "the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity." This is not exactly a sound-bite.

So from the very beginning let us retain as important the need to work at communicating, at simplifying, at educating. If EBM remains the domain of experts we will never be able to bring about the transformation of modes of thought in our societies which will be necessary over the longer term for its success.

[14] Presented by John Richardson, Directorate General for Fisheries and Maritime Affairs, European Commission.

A working definition of the ecosystem-based approach is generally understood as encompassing the following elements:

(a) Sustaining ecosystem health and the activities it supports;

(b) Obtaining and maximizing in the long term the socio-economic benefits resulting from these activities without compromising the ecosystem;

(c) Generating knowledge about the marine environment itself and the impact human activities exert on it.

Each of these elements poses problems for implementation. So let us have a look at some of these.

The first problem posed by EBM is surely that real systems are complex and at best we can model them incompletely. We have looked in the European Union at the different elements of our marine ecosystems; we have begun to assemble information on their spatial distribution; we have analysed the many, and increasingly important economic activities which affect them; and we have identified the many government agencies which deploy their efforts on our coastal waters in order to monitor and enforce the rules on their behaviour. What we have found is at best an approximation to reality. But what is clear is the fragmentation of our efforts to influence it. Currently, our marine ecosystems are dealt with by a plethora of instruments, not by a coherent system of governance.

Our second problem is linked to the concepts of restoring systems to a state of health or maintaining their pristine nature. And yet the world is changing. The climate shifts we are bringing about by our profligate emissions of greenhouse gases are causing changes, some subtle, some massive, to ecosystems. We can hardly ignore these changes and base our immediate ecosystem goals on a denial of this reality. Nor can we adopt a baseline of zero human influence. Our goal is sustainable economic development in the oceans. So we are faced with the reality of shifting baselines and with the perhaps unpalatable need to balance science and economic reality and science and politics.

As we have learned more about our one ocean we have also to understand that it consists of a diversity of ecosystems. The ecological characteristics of Europe's coastal waters and the structure and intensity of the maritime activities which take place in them vary widely between the Baltic, the Mediterranean, the Atlantic and the North Sea, and the Black Sea. The latter, by the way, will become a European Union coastal water with the accession of Romania and Bulgaria. The Baltic is shallow, with a connection to the Atlantic, and minimal tides. The Mediterranean is much deeper, but also has minimal exchange with the Atlantic. The waters of the Black Sea, which are deep, are, however, largely devoid of the oxygen needed for a vibrant ecosystem. The North Sea and the Atlantic seaboard have strong currents and high tidal variation.

So decisions which work for one ecosystem may not be good for another. Centralized decision-making is not the way forward. This is recognized in our Marine Strategy proposal,

which provides for a framework of action to be implemented at the regional level. In other words, no management measures will be adopted from Brussels as this would not be tailored to specific challenges faced.

Our seas are influenced by multiple human activities. In the Task Force set up in the European Commission to develop our maritime policy, we now have no less than 10 Commissioners, responsible for different policy areas, involved in the direction of our work.

We have been aware for a long time of fisheries and shipping as important users of our marine resources, and marine tourism and offshore extraction of hydrocarbons have entered public awareness over recent decades. But fewer of our citizens are aware of the potential riches of blue biotechnology; few notice the proliferation of pipelines and cables on the sea floor. Many have now woken up, thank God, to their interaction with bottom trawling fisheries. And off European coasts we are about to witness a vast expansion of renewable energy generators, starting with wind, but also tapping wave and tidal energy.

The growth in these activities makes it essential to adopt planning systems which can police their competition for the use of the oceans and to ensure that the ecosystems remain healthy or can be restored to health. Currently these different activities are subject to fragmented decision-making by multiple authorities.

A few of our Member States have begun with sophisticated spatial planning systems for their waters, but systems are in their infancy. We have a long way to go.

The final challenge I would like to address is the implementation and monitoring of rules. We live on a few large and many small islands occupying only 30 per cent of the surface of our planet, and surrounded by a vast expanse of ocean. To say that activities on this ocean are difficult to monitor would be an understatement. Even on our coastal waters the number of police officials per square mile is orders of magnitude smaller than on land. The challenge of enforcing rules is all the greater.

B. THE WAY FORWARD

In facing these challenges our work on the Green Paper suggests some elements of a practicable way forward. First, we need to move from piecemeal instruments to integrated arrangements. Luckily, we are not starting from scratch.

Developments in international law have contributed in advance to building the new scenario. The United Nations Convention on the Law of the Sea, to which the European Community is a Party, already offers the possibility to organize activities in the oceans in an integrated fashion, and the Johannesburg Declaration of 2002 points the way forward.

The work on our Green Paper does suggest that at least an integrated analysis of all aspects of human interaction with the oceans is essential, that increased coordination of policies and actions by government is appropriate, and that new actions can help to fill the gaps in existing arrangements.

Secondly, we need to have societal agreement on our goals and an understanding by stakeholders of the reasons for our actions. There are inevitably trade-offs in the use of an increasingly scarce resource. There will therefore be no substitute for decision-making through democratically legitimated public processes. We believe that the legitimacy and acceptability of decisions can be increased by the extensive involvement of stakeholders in these processes. And the more they can be decentralized, the stronger this involvement can become.

Thirdly, we must be aware that no form of decision-making can make the reality of sometimes conflicting interests of economic operators disappear. And there will be cases in which we will have to decide between a better environment and more economic activity. But experience in countries which have taken the road of integrated decision-making suggests that the integration of the best scientific knowledge into the equation, and its careful spelling out to stakeholders, can take the steam out of conflict and bring about a readier acceptance of the necessary decisions. So science serves not just to define our goals and our measures but also to increase their acceptance, and the level of ownership of citizens in the rules they must respect.

These ideas underlie some of the provisions of our Marine Strategy. In identifying the eco-regions within which it should apply, we have tried to draw the boundaries of the appropriate management units for the seas surrounding Europe. It has proven to be more difficult than expected, and we have to recognize that, although detrimental to a pure ecosystem view, social and political realities must be respected.

There are however, clear management units emerging like the Baltic Sea, North Sea or Black Sea. The involvement of regional actors - in the sense of transnational organizations - has to be promoted (where they do not exist) and/or empowered. Exchanges of best practice between these actors should be actively promoted. Thus the efforts undertaken by the Baltic countries to advance the implementation of the ecosystem approach in the Baltic Sea, joining forces within HELCOM (Baltic Marine Environment Protection Commission), as well as the activities carried out within OSPAR by North Sea countries with the same aim, should be highlighted.

I have already referred to the necessity of achieving ownership of agreed rules by stakeholders through their participation in decision-making. But, of course, this is not enough for effective implementation. We also need to reflect on how we can achieve their successful monitoring and enforcement, nationally and internationally. So we are giving a lot of thought and will be consulting extensively on how to improve our performance in this area. In our view, greatly improved surveillance of human activities in the oceans will be essential to this, as will reinforced flag and port state control.

C. THE EUROPEAN UNION STRATEGY

So I would describe our emerging strategy in maritime policy as follows:

Ecosystems are the starting point. The integrated analysis of all human interactions with the oceans and their implications for the ecosystems follow. There will certainly be implications for

the direction of many sectoral policies, whose course can be adapted and developed in the light of the findings of the analysis.

We also believe that the way forward must lie in systems of integrated spatial planning for activities off our shores. We are devoting a lot of thought also to the appropriate tools which will be needed if planning is to be successful. We will need more and better integrated research if sound science is to be able to play the role it must. We need to know more about the oceans and their individual ecosystems; we need to better understand their dynamics. We will need more and better data on the basis of which we can monitor changes and define indicators. Our preliminary analysis suggests that an effort to construct a network of compatible data systems, bringing together information from multiple sources and making it available for multiple purposes, can provide a cost-effective way of doing this.

Extensive mapping of the seabed and of the occurrence of flora and fauna in the waters covering it is likely to be necessary. We are looking also at how to rationalize, integrate, and generalize the many systems of vessel tracking which exist for many different purposes around our shores, with a view to increasing their usefulness and their efficiency.

In other words we are giving a high priority to the tools needed to turn words into effective action. And, of course, whatever we believe we have achieved within the European Union we will want to share with the world community.

PART THREE
A. LESSONS LEARNED FROM IMPLEMENTATION OF ECOSYSTEM APPROACHES AT THE NATIONAL LEVEL

IX. LESSONS FROM IMPLEMENTATION OF ECOSYSTEM-BASED MANAGEMENT OF OCEAN USES IN AUSTRALIA [15]

Abstract

The present paper has two principal aims. First, it aims to provide an overview of Australian examples of implementation of EBM across a broad spectrum of marine/ocean environments and institutional contexts. Early examples include the Great Barrier Reef Marine Park and the North West Shelf multiple-use study. Australia's Oceans Policy and significant revision to environmental legislation (the Environmental Protection and Biodiversity Act) have been the major drivers of wider implementation of EBM in Australia over the past decade. A major whole of government initiative towards multiple-use EBM has been the development and implementation of bioregional marine plans for the Australian exclusive economic zone (EEZ) and the associated institutional arrangements for intergovernmental, stakeholder and science consultation and decision-making. The National Marine Bioregionalization for the Australian EEZ is a practical example of a key science product that underpins a range of cross-sectoral planning and management activities. Practical examples of sectoral initiatives include the development and implementation of an Ecological Risk Assessments for assessing the impacts of fishing on the broader marine environment and Ecologically Sustainable Development Framework for fisheries at a national level, and the ongoing implementation of the National System of Representative MPAs. It is hoped that this necessarily brief overview will provide an entry point for policymakers, managers, researchers and stakeholders to initiate dialogue with the practitioners involved and explore for themselves operational issues that have arisen, the particular lessons learned and the solutions developed to that the next step in the transition to EBM.

The second aim is to proffer some considered views on general issues for advancing the implementation of ecosystems-based management in the oceans, gained from this experience, to stimulate debate and focus discussion on practical next steps in broader implementation of the approach. While the particular details vary among case studies, key ingredients to successful implementation include: (i) sustained political and institutional will to act, including the willingness to make the first practical steps and recognize the need to do so without full knowledge or certainty of outcomes; (ii) clarity of vision and demarcation of responsibilities for strategic policy direction and operational planning and management, particularly at a sectoral level; (iii) recognizing and respecting competing objectives among sectors and looking for creative solutions; (iv) a focus on outcome-based performance; (v) the importance of an ecological spatial framework that has scientific credibility and a strong conceptual foundation to provide a direct translation from science to planning and management; (vi) the need to balance the strong influence of "iconic" places, features, species with the broader requirement for representativeness and assessment of ecological impacts; and (vii) the persuasiveness of binding instruments. Each of these issues will be important, to differing degrees, in the continued implementation of EBM in Australia and elsewhere. However, it is contended that (i) and (vii) have been the determining factors in the progress that has been made in Australia.

[15] Presented by Campbell Davies, Australian Commonwealth Scientific and Industrial Research Organization (see annex).

X. A PRACTICAL APPROACH TO ECOSYSTEM-BASED MANAGEMENT: THE CANADIAN EXPERIENCE [16]

Application of ecosystem approaches to the management of ocean activities does not need to be inordinately complex. In its simplest form, EBM involves consideration of the impacts of a single activity on the biological, chemical and physical components of the ecosystem. In its more complex and challenging application it focuses on the dynamic interactions between the species within an ecosystem, between the biological components of an ecosystem and environmental processes influencing them, between interconnected land, air and marine systems and finally between and among the core components of the marine ecosystem subjected to the stresses of multiple human activities.

In Canada ecosystem approaches to management are being applied in two distinct but complementary ways. In a more holistic fashion through an integrated approach to oceans management and at the same time through the modification of existing and generation of new sector-specific policies, regulations and management approaches. This presentation will provide a brief outline of the two approaches currently being applied and will highlight a few pre-requisites for successful implementation of an ecosystem approach. Suggested elements of an international work-plan to advance EBM will be outlined for consideration.

Canada is a federation with legislative responsibility for the regulation and management of ocean-related activities distributed among several federal agencies. Generally speaking, the national Government has overall responsibility for the management of oceans; provincial and territorial authorities are primarily responsible for land-based activities. To provide a legislative base for a unified and modern management regime for all oceans activities, Canada adopted national umbrella oceans legislation and an overarching Oceans Policy Framework.

Of particular relevance to this discussion is the fact that the Oceans Act, the Oceans Strategy and most recently Canada's Oceans Action Plan are all based on an EAM, and, more specifically, commit Canada to managing activities in and affecting oceans in a way that does not compromise ecosystem health while encouraging multiple uses of ocean spaces. Canada has adopted a combination of objective-based measures and area-based approaches to the planning and management of activities and has made ecosystem-based considerations central to its approach to integrated management.

In terms of the objective-based approach, we have developed a national conceptual framework to guide the application of the ecosystem approach. The frameworks, as well as companion implementation tools are focused on three key elements which contribute to ecosystem health: the structure, or biological organization of the ecosystem, the vigour or productivity of the ecosystem and water and habitat quality properties of the ecosystem.

[16] Presented by Camille Mageau, Department of Fisheries and Oceans, Canada (see annex).

In terms of the area-based approach, our national policy framework sets out two complementary approaches to guide the application of the ecosystem approach: management of large oceans management areas (LOMAs), and management of coastal management areas. In terms of LOMAs, all marine waters within Canadian jurisdiction have been delineated into 17 eco-regions, the boundaries of which have been set to capture large-scale ecosystem features and patterns including geomorphologic, oceanographic and ecological characteristics. The LOMAs extend from the coast out to the outer boundary of the EEZ. Within these large regions, are the smaller, nested coastal management areas. These areas deal primarily with issues related to the land-water interface and land-based activities that have an impact on the marine environment.

Via our Oceans Action Plan, we have advanced our EBM approach in five priority LOMAs - three in the Atlantic Ocean, one in the Pacific Ocean, and one in the Arctic Ocean. For each of these areas, existing baseline information on the status and trends of physical habitats (soil and subsoil), the water column, oceanographic processes and biological components including their trophic relationship is being assembled. An inventory of human activities is also being compiled and an assessment of the individual and cumulative impacts of these activities on significant components of the ecosystem is being conducted. As well, purely practical considerations such as administrative, historical, cultural uses as well as other management approach and zoning schemes are being considered. To facilitate application of the area-based approach, guidance tools have been developed to assist with the identification of significant components of the ecosystem which may require special management attention. Science-based criteria are used to identify areas which are ecologically and biologically significant with respect to surrounding areas, based on their uniqueness, degree of aggregation, fitness consequence, resilience and naturalness.

A similar diagnostic tool is now being developed to support the identification of ecologically and biologically significant species and community properties (above the species level) within the planning areas. These species are considered significant because they play a pivotal role in the food web or serve another key role in the ecosystem. The ecosystem-based assessments conducted also provide for the identification of impacted species. Impacted species can include Species at Risk, overfished species or weak links in the food chain. Impacted areas or habitats which are threatened, degraded are also identified during the assessment phase.

Identification of these areas, species and relationship of particular ecological interest serve to identify where ecosystem objectives need to be set on a priority basis. The identification of ecologically and biologically significant species and areas, as well as impacted areas and species also supports the ecological basis for the design of Canada's ecosystem-based network of MPAs.

It is at this point, that the area-based and objective-based approaches are combined and that the process to define specific priority ecosystem objectives is initiated. The concept of EBM has been simplified for application to ocean management by the development of an Ecological Framework which focuses on the three key elements which contribute to ecosystem health. These elements include the biological organization or structure of the ecosystem, the vigour or productivity of the ecosystem and finally the physical and chemical properties of the ecosystem. The Canadian framework for an ecosystem-based approach initially focuses on the articulation of "goal statements" for each of these elements.

The biological organization or structure of the ecosystem considers the biological diversity (at three levels of organization, genetic diversity, species diversity and habitat diversity) as well as the ecological role and interactions of the various biological components. Organization of the ecosystem is also defined by the trophic structures, the complexity of the food webs, the age structure and relationships, as well as the spatial distribution of the biological components. Ecosystem objectives focused on organization are therefore set to "conserve enough components so as to maintain the biodiversity and natural resilience of the system."

The vigour of the ecosystem addresses the productivity of the ecosystem with particular attention to interactions affecting energy flows and reproductive capacity. The overall goal to maintain productivity is therefore expressed as "conserving the function of each component of the ecosystem so that it can play its natural role in the food web and contribute to the overall productivity of the ecosystem."

The abiotic properties of the ecosystem that is the nature of the oceanographic processes as well as the physical and chemical quality of its components influence both ecosystem structure and function. As such, the goal is to "conserve the geological, physical and chemical properties of the ecosystem so as to maintain the overall marine environmental quality."

These overarching goal statements (or what may be referred to as "conceptual objectives") serve as the equivalent of "policy statements". If however, they are to provide planners and regulators with the guidance needed to manage human activities; they need to be much more specific, measurable and operational.

Two different but complementary approaches to the identification of operational objectives are currently being tested in the five large oceans management areas situated in waters of the Beaufort Sea, off the north central coast of British Columbia, in the Gulf of St. Lawrence, on the Eastern Scotian Shelf and in Placentia Bay and the Grand Banks of Newfoundland and Labrador. The bottom-up or activity based approach involves establishing ecosystem-based objectives based on a review of the activities which may have a significant impact of specific ecosystem properties or components. This approach is particularly useful in incorporating local and traditional knowledge and in data-poor areas.

The top-down or ecosystem property-based approach is based on the identification of key ecosystem properties and components without prior consideration of human activities which may be impacting the system. Combining the two approaches blends the rigour of the scientific process associated with the ecosystem driven analysis with the more management-oriented impact-driven approach. Identifying ecosystem objectives is made even more practical and efficient if ecologically and biologically significant species and areas and the rare and depleted species and habitats needing rehabilitation are identified early in the process.

The identification of ecosystem objectives and selection of the indicators most suited to track the ecosystem property are at various stages in the five large ocean integrated management areas in Canada. Nevertheless, key lessons have already been learned. Above all, there is a need for a high degree of patience. The process to develop an objective-based integrated oceans

management plan for one of the large, data-rich ocean management areas has taken almost eight years.

To be effective, application of an ecosystem-based approach to management requires good but not perfect science, but most importantly requires scientific assessments and advice which integrate data collected for very different purposes, over different spatial and temporal scales.

Another challenge facing the scientific community has been the requirement to provide "un-ambiguous" and risk-based scientific advice in support of decision-making. While the starting point must be the use of existing scientific and anecdotal data, critical data gaps will emerge, and must be taken into account in managing the risk. Ecosystem-based scientific advice and selection of management measures cannot wait for critical data gaps to be filled. There needs to be a willingness to work with some uncertainty. We do not have, nor will we ever know all of the answers; but we do need to embrace adaptive management in order to regularly re-evaluate advice and adjust management decisions as information becomes available to fill the critical data gaps.

Application of an ecosystem approach does not have to be complex or frightening; it can be progressive and evolutionary. Canada has incorporated key elements of the ecosystem approach into a variety of legislative, regulatory, policy and management instruments. Recent Canadian legislation, such as the Species at Risk Legislation provides for the development of ecosystem-based and multispecies recovery strategies. Amendments to older statutes such as the Canadian Environmental Assessment Act have also incorporated the concept.

A number of fishery related policies in Canada address the concept of an EAM. For example, the Policy Framework for the Conservation of Pacific Salmon targets the restoration and management of genetically diverse wild salmon populations and their supporting habitat including management of watershed areas of critical importance to the different life stages of salmon. Traditional single-species assessment and management has evolved towards an Objective-Based Fisheries Management approach in which conservation objectives including trophodynamic linkages are identified and respected.

Application of an ecosystem approach is also being included in policies and regulatory instruments affecting other marine sector-specific activities. One such example is the identification of alternative ballast water exchanges zones, selected because of their ecological conditions non-conducive to the survival of invasive species thereby reducing risk to structural and functional damages to the ecosystem. A policy is also being developed to address impacts on benthic habitats and sensitive areas with particular attention on sensitive and ecologically significant habitat areas. Similarly the development of an ecosystem-based assessment of the impact of seismic sound on critical biological functions of key ecosystem components contributed to improved policy and regulatory instruments which guide oil and gas development in Canada.

It is my view that a collaborative international work-plan to advance EBM should be developed. Such a workplan should include the collation and interpretation of the international body of social and ecologic science related to a specific planning area combined with a review of

human activities which may be impacting that ecosystem. International collaboration need not be limited to the sharing of information and the spatial application of the ecosystem approach. There is a large body of science advice that can be assembled, peer reviewed and made available as a common basis for decision-making. Existing international scientific advisory bodies and existing intergovernmental and governance mechanisms offer a very good starting point for implementation of EBM in international waters.

Elements of the workplan are already under development. For instance, a detailed guidance document for the identification and application of objective-based and area-based indicators has been developed and is being pilot-tested globally. This work, sponsored by the UNESCO Intergovernmental Oceanographic Commission and others provides methodologies and tools to facilitate integration of social, economic, ecosystem and governance consideration the management of activities occurring in coastal and ocean areas.

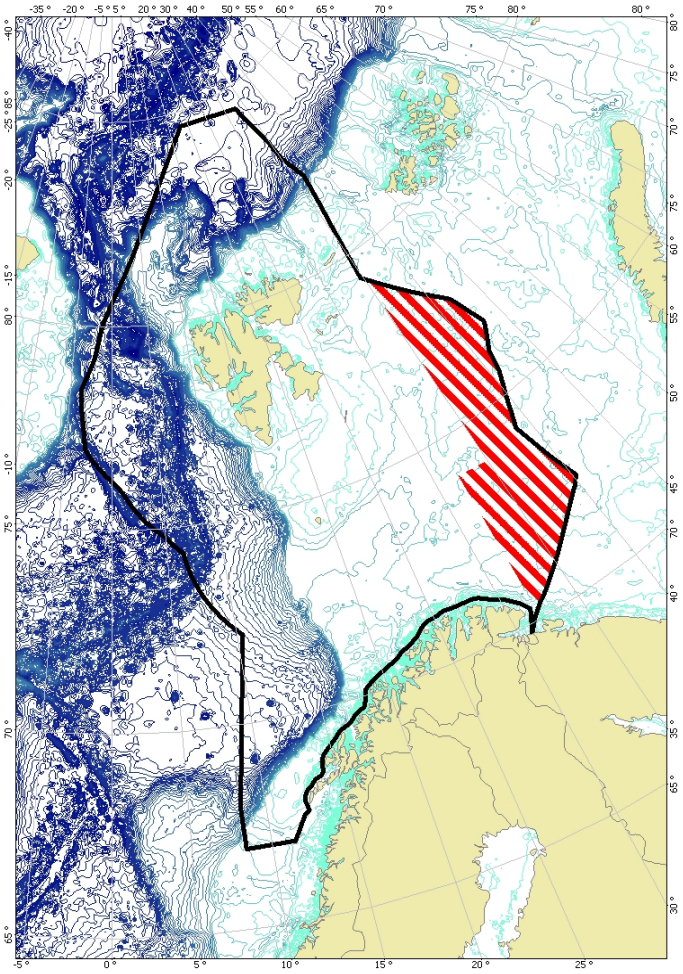
In conclusion, demystification, simplification and a progressive application of the ecosystem approach by existing governance bodies, using the wide variety of policy, legislative and capacity-building tools available to the international community is achievable. It's a question of will.

XI. THE NORWEGIAN ECOSYSTEM-BASED MANAGEMENT PLAN FOR THE BARENTS SEA AND SEA AREAS OFF THE LOFOTEN ISLANDS [17]

Introduction

In June 2006 the Norwegian Storting (Parliament) passed a Government white paper for the establishment of an integrated, EBM plan for the Barents Sea (Anon., 2006). The management plan covers the Norwegian EEZ and the fishery protection zone around the Svalbard archipelago (figure 9). It is a bottom-up plan building on existing management structures, by bringing them together, rather than replacing existing management regimes with a new system. In this way the management plan is an evolution of existing management rather than an evolution.

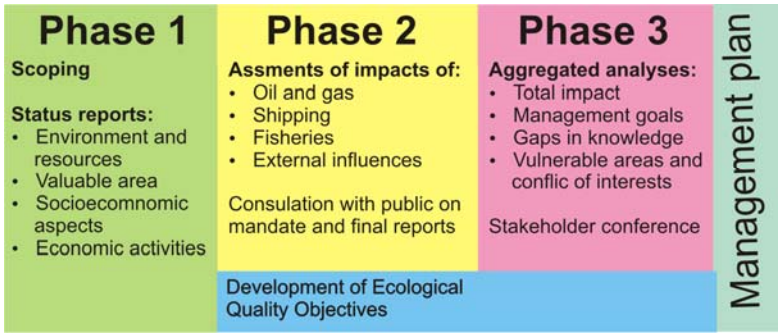
Figure 9
The Barents Sea. The area covered by the management plan is shown by the black line. The red hatched area is the area of overlapping claims between Norway and Russia.



[17] Presented by Erik Olsen, Institute of Marine Research, Norway (see annex).

Development of the plan started in 2002, following the 2001 parliament election when a new Government took seat. In their inauguration statement (Anon., 2001) the new Government promised the development of an integrated management plan for the Barents Sea. The promised management plan came in parallel to the Johannesburg Declaration (United Nations, 2002) where the signatory countries (among them Norway) promised to work towards sustainable, EBM of the marine environment by 2015. The plan was developed under the auspices of an inter-ministerial steering group headed by the Ministry of Environment, but with the Ministry of Fisheries and Coastal Affairs, Ministry of Foreign Affairs and Ministry of Petroleum and Energy. The steering group brought in their underlying research institutes and directorates to produces the scientific basis and give advice through the development process. That process started in 2002, and lasted for 3.5 years until the Government white paper (Stortingsmelding) was presented in March 2006. Figure 10 gives an outline of the phases during the development of the management plan, with the main reports/analyses produced at the different steps.

Figure 10
Time-plan for the development of the management plan from 2002 to 2006



Transparency and openness was a fundamental requirement for the development process, which was carried out by making all reports publicly available, through public meetings at different stages in the process, and through public consultation on plans for assessments, and so on. Another important prerequisite for the development process was that the time frame was 2002 – 2006; by 2006 the Government wanted to present the plan. With this strict timeframe there was little room for new, in-depth analyses, and therefore the plan is based on the best available current knowledge (as of 2003).

In the following paper we will briefly describe the stages of the development of the plan and the main management tools presented in the plan.

A. INITIAL PHASE

Defining the extent of the management plan, both geographically and temporally together with production of status reports on the Barents Sea and surrounding area were the main tasks in the initial phase of the development of the plan. The geographic extent was decided to cover the Norwegian EEZ and the fishery protection zone around the Svalbard archipelago. To the west,

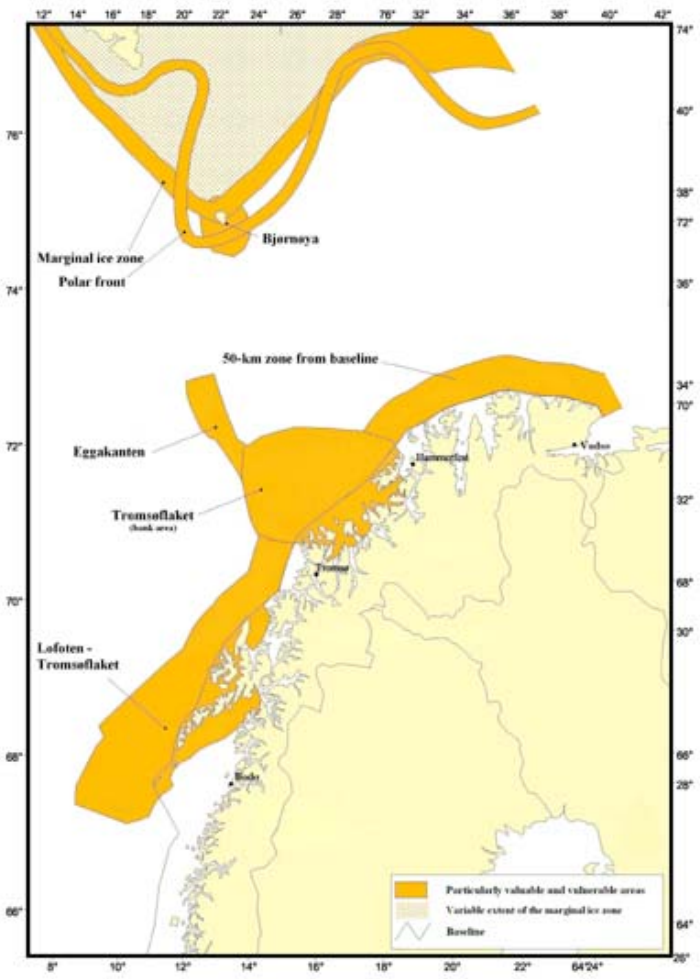
the plan was limited by the lower end of the continental slope, and to the south, by the Lofoten Islands (see figure 9). To the coast the plan was limited to 1 nautical mile offshore of the coastline. This excludes bays, archipelagos and fjords from the management plan area as these coastal areas are to be managed according to the European Union water directive. Thus the plan is aimed at managing an ocean area, but the effects of ocean activities on coastal areas were central issues that were evaluated during the development process.

Another decision during the scoping process was that the plan was to be based on comprehensive assessments of current and future (up to 2020) impacts of human activities on the ecosystem and the society in the region for each of the sectors: petroleum, fisheries, shipping and external influence (e.g., pollution stemming from outside the ecosystem). In order to achieve this, a set of common variables was developed to be used in the impact analyses to ensure that all impact assessments were comparable. The variables used covered the physical habitat, the biological components and socio-economic factors.

Phase one also encompassed the development of a host of status reports on issues ranging from the state of the ecosystem, the socio-economic state in the region and identification of valuable areas. For the full list of status reports see the Government website (http://www.dep.no/md/norsk/tema/svalbard/barents/).

The report identifying the valuable areas in the region (Olsen and von Quillfeldt, 2003) became especially important throughout the development and the following political debate. In that report several areas were identified as especially important, and this evaluation followed the development of the plan and was presented in the final plan as a map over the most valuable and vulnerable areas in the Barents Sea (figure 11).

Figure 11
Ecologically valuable areas identified in the Barents Sea



The six valuable areas identified in the report and are shown in figure 11, and cover the coastal areas of mainland Norway from Lofoten in the south-west to the coast of Finnmark in the east. Offshore valuable areas were identified around Bear Island (Bjørnøya), along the polar front (where warm Atlantic waters meet cold arctic water masses), and along the ice-edge. All of these areas were classified as valuable based on an assessment of their importance for the biological production of the ecosystem, either as spawning, breeding or important feeding areas for several species.

B SECTOR-WIDE IMPACT ASSESSMENTS

Assessing the impacts of all human activity on the ecosystem and society in the Barents Sea region was a central step in the development of the plan in order to understand the present and future pressures and challenges facing the Barents Sea. This process was split into four parallel impact assessments: (a) petroleum activities (Anon., 2003); (b) fisheries (Anon., 2004a); (c)

shipping (Anon., 2004b); and (d) external influence (e.g., pollution from outside the area, alien species, climate change) (Anon., 2004c). The assessments were based on the best available current knowledge, but owing to the time-constraints set for the development of the plan there was no room to conduct new research to fill apparent knowledge gaps. The main findings of these impact assessments, up to 2020, were as follows:

(a) Petroleum activity: its expansion will be the main change in human activity in this period. Possible impacts from oil spills and risks related to rising transport volumes;

(b) Fisheries: management is currently based on the precautionary approach. Illegal, unreported and unregulated (IUU) fishing and insufficient control may have serious impacts on resources, environment, trade and local communities;

(c) External influence:

(i) Pollution: the situation in 2020 is likely to be unchanged from 2006. Inputs of "old" hazardous substances are expected to decrease, but they are already dispersed and degradation is slow. Inputs of "new" hazardous substances are expected to increase;

(ii) Introduction of alien species: this is a serious threat, which will increase as tanker traffic increases. It may result in substantial changes in ecosystems;

(d) However, for a longer time frame, up to 2080 it was clear that the greatest challenge to the Barents Sea was climate change. The most recent Arctic Climate Impact Assessment report shows that the Arctic, including temperatures in the Barents Sea are expected to increase by ~2°C, resulting in large changes in the distribution, abundance and migration of the species living in the area.

C. Development of ecological quality objectives

Parallel to the impact assessments, a set of ecological indicators and associated objectives were developed by Norwegian and Russian Scientists (von Quillfeldt and Dommasnes, 2005). Basing their work on the OSPAR work, and the recent set of indicators developed for the North Sea, a set of 40 EcoQOs was developed for the Barents Sea covering the following areas:

(a) Physical environment;

(b) Phyto- and zooplankton;

(c) Ice-edge;

(d) Fish and fisheries;

(e) Marine mammals;

(f) Seabirds;

(g) Benthos and benthic habitats;

(h) Vulnerable and threatened species;

(i) Alien species;

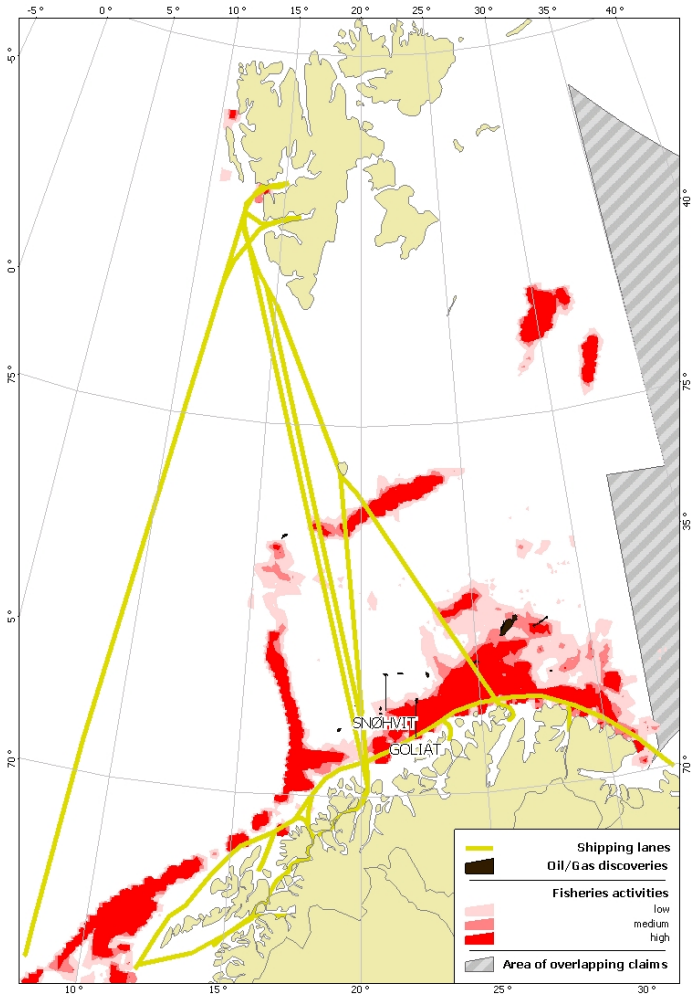
(j) Pollution.

Most of these are based on existing data series, or existing analyses done for stock assessment or environmental assessment, but a large minority are new indicators requiring either new research on existing data to produce aggregated indicators, or requiring entirely new data (e.g., monitoring of the benthic habitat).

D. AGGREGATED ANALYSIS

The last analytical phase of the development of the management plan was phase 3 (see figure 10 above) where the results from the sector-wise impact assessments were brought together to analyze the total anthropogenic impact on the Barents Sea. This proved more difficult than anticipated both owing to the differences between the different impact assessments, and for lack of tools to combine these. Therefore this stage was mostly qualitative, with one notable exception: areas use. In this stage an in-depth Geographic Information Systems analysis of the area use by different activities was carried out to identify areas of potential conflict between activities, and between human activities and ecologically valuable areas. An example of this kind of analysis is shown in figure 12.

Figure 12
Map showing fisheries activities (based on data from 2001), shipping lanes and oil and gas discoveries in the Barents Sea



E. THE PLAN

Management goals

Also during stage three, management goals from the different sectors, from national legislature and from international agreements/protocols were brought forth in order to develop a set of overarching management goals for the whole ecosystem. The main goal for the plan is to: ”safeguard marine ecosystems to ensure long-term value creation and ensure that activities in the area do not threaten the natural resource base or opportunities for value creation in the future”.

The plan also specifies specific goals for each sector, for example (the following list is not comprehensive):

(a) Prevent or limit pollution:

(i) Build up knowledge;

(ii) Follow up and develop international initiatives;

(iii) Ensure zero discharges of pollutants and produced water from petroleum activities (”Zero-discharge goal”);

(b) Ensure that seafood is safe;

(c) Reduce the risk of and take steps to prevent oil spills:

(i) Ensure a satisfactory level of oil spill preparedness (tug capacity, etc.);

(ii) Enhance maritime safety;

(d) Mandatory routeing and traffic separation schemes;

(e) Maintain biodiversity at all levels:

(i) Take steps to protect particularly valuable and vulnerable areas;

(ii) Manage commercial resources (e.g., fish) according to the precautionary principle;

(iii) Avoid introduction of alien species;

(iv) Maintain and safeguard nature types and habitats;

(v) Survey benthic habitats and introduce measures to minimize impacts on valuable and critical habitats.

F. GAPS IN KNOWLEDGE

The plan is a science-based plan based on a fairly good scientific understanding of the Barents Sea. Even so, there are gaps in our knowledge of the system that need to be filled in in order to handle important management questions raised by the concept of EBM. These were collated from all gaps in knowledge identified through the whole development process and were prioritized according to their importance for management decisions, especially the implementation of the management plan - being the implementation of the proposed EcoQOs (Anon., 2005). The three most important gaps in knowledge are:

(a) Mapping the bottom habitat;

(b) Studies of ecological interactions between species and components of the ecosystem;

(c) Studies of the effects of pollutants.

The plan calls for the following measures to fill these identified gaps:

(a) A better coordinated environmental monitoring system, to monitor the state of the ecosystem and environmental trends (indicators, reference values, action thresholds);

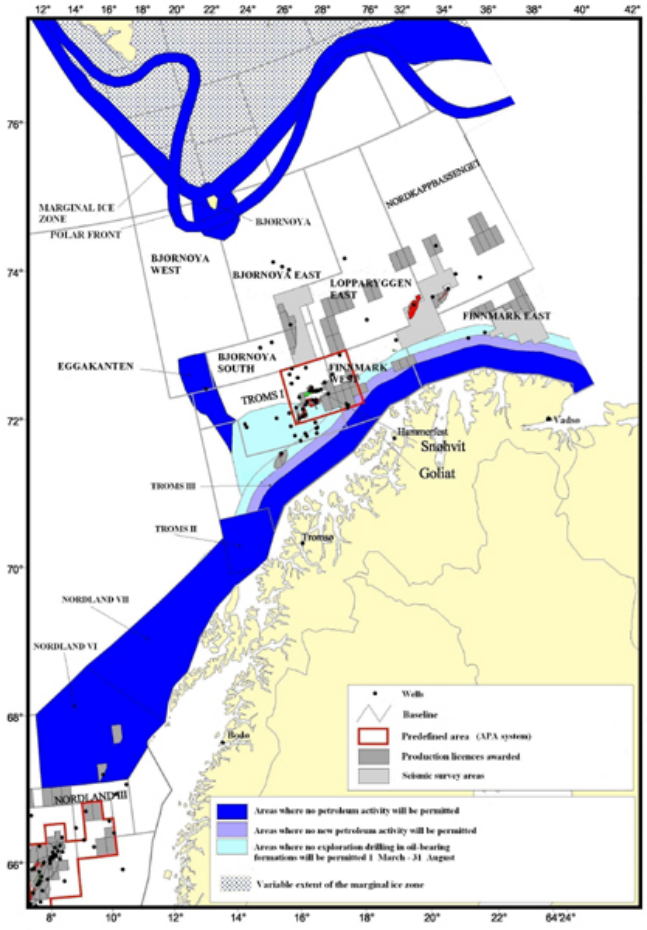
(b) Expansion of research activity and surveys;

(c) Steps to fill gaps in our knowledge: activities under the Research Council of Norway.

G. FRAMEWORK FOR PETROLEUM ACTIVITIES

The framework for future petroleum activities was the aspect of the management plan most fiercely debated during the development of the plan. The most extreme points of view call for either a total closure of the area for all petroleum activities, or opening all areas to the activities. The plan presents a compromise framework for petroleum activities in the region with the clear premise that this framework will be reassessed at the first revision of the plan due in 2010. Figure 13 shows the framework for petroleum activities. The plan closes the coastal and near-coast areas from Lofoten to Finnmark for all petroleum activities. In addition the areas around Bear Island, the ice edge, polar front and the continental shelf break (Eggakanten) area completely closed. These areas correspond to almost all the valuable and vulnerable areas identified at the start of the development process (figure 11 above). The areas of the Tromsøflaket bank area (another valuable area) are only closed during part of the year, while a narrower coastal zone (grey band in figure 13) is not open to new activities, meaning that activities that previously have been granted licenses will be allowed to take place. In the open, ice-free areas of the Barents Sea no areas are closed. This does not mean that it is free for all. Standard legislature, analyses, applications and environmental impact assessment must still be carried out, and only a limited number of smaller areas (blocks) are opened at any time.

Figure 13
Framework for petroleum activities in the Barents Sea from 2006 to 2010



H. IMPLEMENTATION, COOPERATION AND REVISION

Cooperation between institutes, directorates and ministries was fundamental requirement for the plan to be developed. EBM requires sector-spanning cooperation, the abolishment of old "turf-wars", and an increased level of trust between the participating government bodies and groups. Transparency and stakeholder involvement are also important to secure a broad acceptance, interest and compliance with an EBM plan. These factors are also of great importance when the plan is implemented, and to facilitate this, the Norwegian plan introduces several measures to realize cooperation, transparency and stakeholder involvement.

The plan calls for an annual assessment of the state of the Barents Sea, using ecosystem indicators. To achieve this, an advisory group consisting of all institutions carrying out monitoring in the Barents Sea is set up to coordinate and cooperate on monitoring. Results will be published annually, and reports, analysis and data will be made available through internet portals.

Every 4 years the plan is due for a revision where the foundations for previous decisions are to be reassessed. Again, a broad group consisting of all institutes carrying out monitoring/research in the Barents Sea is set up to give advice on developments of the plan. This ensures that the plan is dynamic and that new knowledge provides a basis for reassessing previous management decisions.

A forum for environmental risk assessment is also set up between government institutions and shipping and the petroleum industry. This forum has as its task to strengthen the work on environmental risk assessments in relation to shipping and petroleum activities.

To ensure that stakeholder views are taken into account the plan calls for the establishment of a reference group where stakeholders (industry, academia, non-governmental organizations (NGOs) and others) can meet with government to give input to the implementation and revision of the plan.

International cooperation is also fundamental for successful EBM. Norway shares management of the Barents Sea with Russia and a successful management plan for the Norwegian EEZ requires good cooperation with Russia on sustainable, EBM of the whole Barents Sea. In addition EBM requires dealing decisively with important global issues like far-transported pollution, existence of threatened species and climate change. Focus is therefore placed on Norway participating in the global forum to develop comprehensive and effective global regulations.

H. DISCUSSION

The Norwegian management plan for the Barents Sea is one of the first practical implementations of EBM of a LME. It is a bottom-up evolutionary approach, building on existing legislature, institutions and management processes. It is a science-based plan, and science is at the focus during the implementation and coming revisions of the plan. The plan covers all sectors of anthropogenic activity in the area, but is focused on the environmental effects of human activities. It is therefore a challenge, at future revisions, to include more socio-economic and societal considerations in the plan. However, the main challenge through the development and the implementation is to ensure the necessary cooperation among participating bodies, transparency to the public and stakeholder involvement.

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XII. ECOSYSTEM-BASED FISHERIES MANAGEMENT IN ICELAND: SOME PRACTICAL CONSIDERATIONS [18]

Introduction

Since the introduction of the precautionary approach concept in Rio de Janeiro in 1992 and the adoption of the FAO Code of Conduct for Responsible Fisheries in 1995, managers and fisheries scientists providing advice have for many years discussed and argued definitions of ecosystem-based fisheries management or EAF. This concept has been on the agenda of international forums in recent years and on several occasions dedicated international conferences and symposia have been held. The Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem (FAO, 2002; Sinclair and Valdimarsson, 2003), held in 2001 addressed the scope of the concept and subsequently the FAO produced basic guidelines for implementation (FAO, 2003). As a follow-up, immense efforts have been devoted to define indicators and scientific criteria to be applied. However, despite all these efforts, we are still not moving very fast towards implementation and there is even some misconception as to what this is about.

The present short paper is written from the point of view of a marine research organization which has many marine scientists onboard as well as being principal advisory authority to the government and the fishing industry in Iceland on fisheries and ocean matters. The paper is also written from a perspective of a modern fishing society, with modern industry and a modern economy that are heavily dependent on well-managed marine resources and the marine environment.

In the paper the complexity of EAF is recognized and therefore until a fully fledged system is in place, it is suggested to move forward in a stepwise non cross-sectoral approach. Some practical considerations on EAF, based on the single-species approach in Iceland, are suggested and discussed, influencing the daily work of assessment scientists.

A. ECOSYSTEM APPROACH TO FISHERIES – THE ESSENCE

It is important to recognize that we need not find a single definition of EAF, but rather accept the common sentiment, which involves managing human activities in such a way that we determine the course of action and have in advance predicted the consequences of our actions with the aim of securing sustainability and optimum utilization of the resources and the marine environment. In principle this implies not only taking note of the resource we are directing our utilization towards, but also other resources that may be affected by our activity and potential effects on the physical environment that these resources inhabit. In reality, we are talking about a framework or mechanism for environmental risk assessment and management of activities that one has developed for resources on land for quite some time.

[18] Presented by Jóhann Sigurjonsson, Marine Research Institute, Iceland (see annex).

In essence such a framework would consist of a mechanism that clarifies causative links between relevant components that are affected by the fisheries or other human activities. This involves measuring values of different interacting components or resources and weighing values of different resources one against another, in monetary, ecological or other terms, based on a ruling which the society determines at any given point in time. Then authorities make decisions on where to go and these evaluations are translated into management actions.

B. The 2001 Reykjavik Conference and the ecosystem approach to fisheries

The 2001 Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem (FAO, 2002; Sinclair and Valdimarsson, 2003), addressed the scope of the concept and subsequently the FAO produced basic guidelines for implementation (FAO, 2003). Here one identified EAF as an integrated management, holistic approach with a broad set of conservation objectives. But it was recognized that for a full-fledged system that would be suitable to address this new approach, one would need far better understanding of the ecosystem components and dynamics of the ecosystem, one would need a much broader angle of view to fisheries management than was the practice, and one would need an institutional and legal framework that would suit the new situation, in addition to strong political commitment and stakeholder participation.

However, one of the main conclusions of the scientific symposium that was held in conjunction with the Reykjavik meeting, was that by conducting our single-species management of fisheries with greater care and more discipline than up to now, we could have done much better with respect to ocean resource management than has been the case. Indeed, had fishing effort worldwide been less intense in the past, we would be well on our way towards EAF. Many of the problems that the new and broader concept is to address would not have been on the agenda under a more cautious fishing regime in recent decades.

Therefore, it was concluded that one should not wait until all conditions and equipment for EAF have been developed, since many of the measures that are being implemented under single-species management schemes are in the spirit of such an approach. We need simply do it better. Also it was stressed that while a full-fledged EAF scheme of the ocean resources is the ultimate goal, it needs to be understood that in order to achieve this we may have to undergo a lengthy incremental process. So it was advocated to start immediately but in a stepwise process as experience and circumstances would allow.

In recent years the scientific community, including the ICES scientists, have devoted much effort to defining a more holistic framework for use in fisheries management. It should be recognized how much thoughtful work has been done in shaping the concept (e.g., Gislason and others, 2000; FAO, 2003; Sainsbury and Sumaila, 2003; Sinclair and Valdimarsson, 2003; Cury and Christensen, 2005; Daan and others, 2005; Garcia and Cochrane, 2005; ICES, 2005; O'Boyle and others, 2005), developing the appropriate framework and in taking steps towards implementation. So we can say good progress is being made, but it is complicated to determine objectives, criteria and appropriate/relevant indicators, and in general the matter is still at a design or development stage. This certainly applies to Iceland, where the Government, however, has published an official policy document on ocean matters with EAF as part of the portfolio.

C. SOME PRACTICAL EXAMPLES FROM ICELAND

Traditional measures

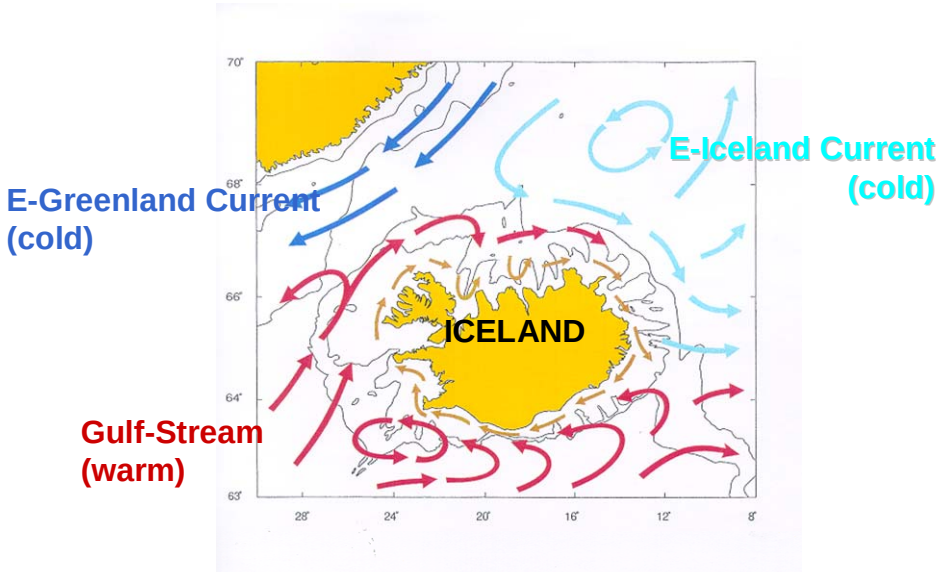
So while this development has taken place, many countries have continued to elaborate on a single-species approach with standard ingredients such as those that have been developed and improved in Iceland and elsewhere in recent years. These comprise TACs to limit total fish removals, fishing gear spatial/temporal restrictions, restrictions on vessel sizes, selective mesh size and gear, season length and timing, multi-species interactions and area closures, short or long term. We can say all these elements are essential and in the spirit of EAF.

D. GEOGRAPHICAL SCOPE

The currents and topography around Iceland (figure 14) provide oceanographic conditions that result in a relatively closed system on the continental shelf around the island. The geographical position of Iceland on the ocean ridges means that the country is in the vicinity of mixing areas of the warm and cold ocean currents. The warm North Atlantic current originating in the Gulf of Mexico meets with the polar East Greenland current, flowing south along the East Greenland coast. Close to the coast there is a coastal current which flows clockwise around Iceland and is formed by mixing of warm oceanic water with fresh water from land.

So the area around Iceland has been defined as one of the LMEs owing to these rather well defined conditions (Ástthórsson and Vilhjálmsson, 2002). This encompasses the 200 nautical mile EEZ around Iceland, about 760 thousand km^2, which is seven times the area of the island. The scope would, however, have to be adjusted, extended or reduced, with respect to migratory behaviour and biology of the species and stocks in question, for example, one would have to extend such an area beyond the Icelandic EEZ in order to address questions related to the Atlanto-Scandian herring (*Clupea harengus*) stock, a highly migratory species that occurs in national waters of several countries, while less mobile stocks such as lobster (*Nephrops*) and shrimp (*Pandalus borealis*) stocks would be managed on a smaller scale area basis within the Icelandic EEZ.

Figure 14
Ocean currents and topography of the Iceland seas with warm Gulf Stream coming from the south-west and cold currents reaching the northern part of the island with East Greenland and East Iceland currents



E. AREA CLOSURES

Although MPAs are a popular theme when discussing EAF, they are only one of many potential tools of a full-fledged EAF and are not likely to alone meet our goals in managing the stocks (see, e.g., Stefánsson, 2003). But temporary closures of areas have proved important tools in the Icelandic context and have been used extensively. Figure 15 shows a map of areas closed permanently or temporarily for bottom trawlers, either owing to too high an abundance of juvenile fish or unwanted by-catches of non-target species (Jaworski and others, 2006). Here one can see a map of areas closed permanently or temporarily for bottom trawlers (red and orange areas) or with compulsory sorting grid provisions (shaded areas).

Likewise extensive areas have been closed for long-line fishery as shown in figure 16. In all cases we are dealing with measures imposed in order to conserve certain biological resources, spawning grounds, juveniles or unwanted by-catches. Here criteria have been established to tell when and where areas need to be closed where one resource is valued on its own or weighed against another in economic or biological terms, or both. In many cases, long-term area closures have been established after repeated short-term closures have been set after too high a proportion of unwanted catch was found upon inspection by observers.

Similarly, there are extensive vulnerable coral reef areas at the south coast of Iceland, that have now been fully protected for all fishing activities after ocean floor mapping became

available and surveys were conducted. The gathering of information and the definitions of areas to be closed or protected have always been done in close cooperation among all main stakeholders, namely, the fishing industry, authorities and the scientific authority.

Figure 15

Closure of fishing grounds around Iceland from bottom trawling. Year-round closures in red (horizontal red lines, part of the day only), closures part of the year in orange, and areas with trawling permitted but sorting grids imposed (vertical lines).

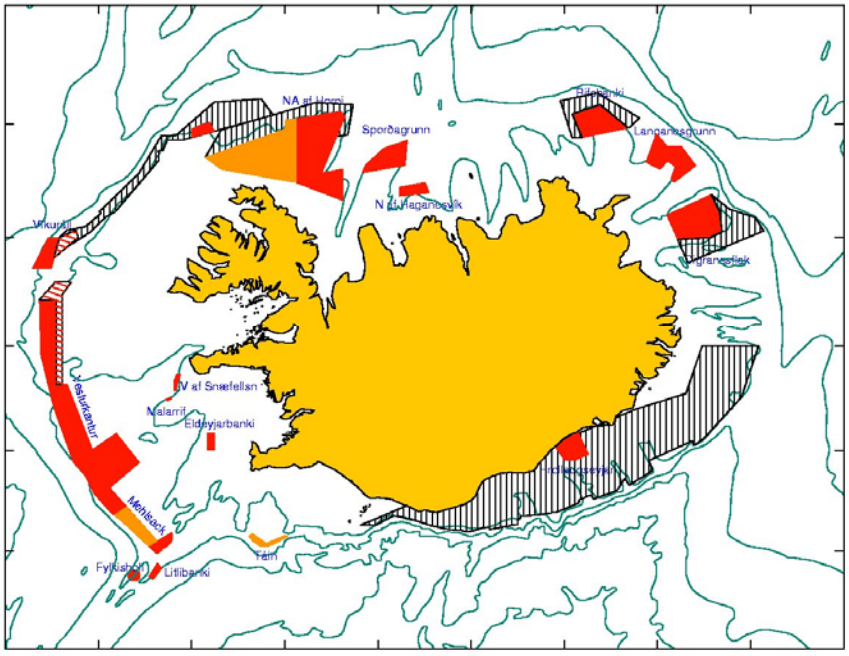
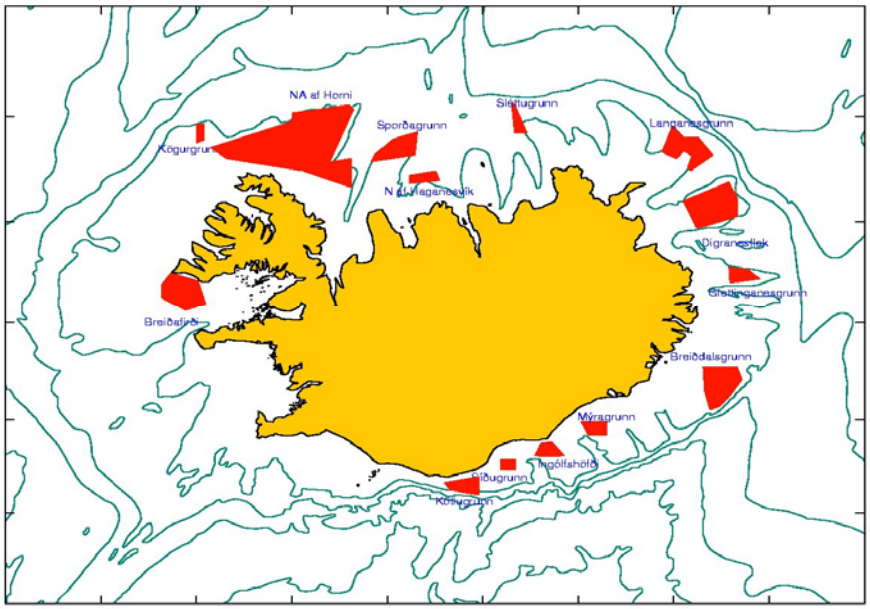


Figure 16
Year-round closure of fishing grounds around Iceland from long-line fishing (red areas)

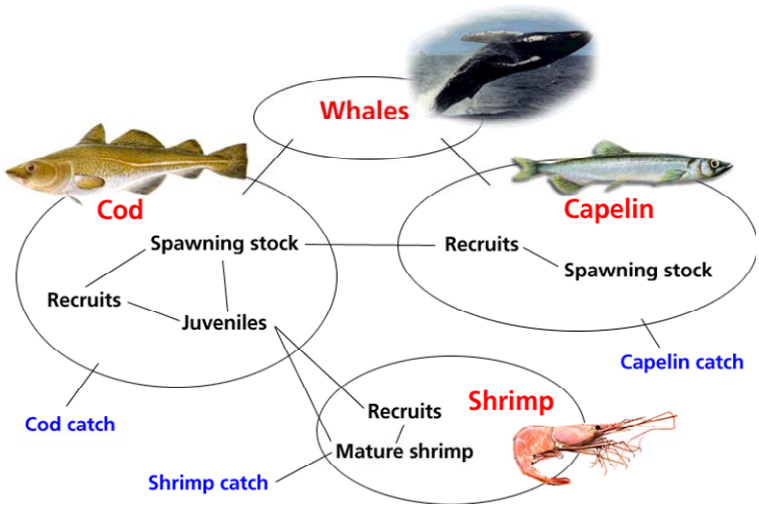


F. MULTISPECIES MANAGEMENT SYSTEM

Weighing one resource against another is how authorities and stakeholders in Iceland have, with the help of harvest control rule, managed the economically valuable cod stock, that feeds on capelin and shrimp (Baldursson and others, 1996; Daníelsson and others, 1997; Jakobsson and Stefánsson, 1998). Every year sufficient quantity of capelin is left as fodder for the cod and sufficient quantity is left for capelin to spawn. Owing to the close dependence on capelin as food for cod, short-term predictions for cod are significantly linked to predictions of the development of the capelin stock in the following year. And since cod is valuable in economic terms, the long-term strategy was to build up the cod stock at the cost of lower shrimp yields. And finally, while in terms of biomass, whales constitute a major component of the marine life in Icelandic waters (Sigurjónsson and Víkingsson, 1997) and may significantly influence the yield of the interacting fish stocks, different views arise as to how to value and manage the whale stocks (Stefánsson and others, 1997). Here again, weighing of components provides a basis for longer-term management strategies (figure 17).

It is the task of the society, so to speak, to put price tags on these resources, on whatever basis, and to take a well-balanced management action with predicted consequences. A well-founded EAF framework is an appropriate tool for the society to deal with such questions.

Figure 17
Multispecies stock system and management off Iceland



G. PRAGMATIC ECOSYSTEM CONSIDERATIONS

Ecosystem approach to fisheries as part of routine scientific fish stock assessments

The above-mentioned cases are well worth referring to when discussing EAF. Here scientists and fishing industry have been heavily involved. And we can add that many research activities in recent years have been directed towards a more holistic view such as bottom trawl surveys and other resource surveys that were initially targeted at certain important fish stocks but are now also a valuable source of information on many related or non-targeted, often, non-commercial species.

But we need to note that for scientists conducting their daily fish assessment work, it is far from likely that the ecosystem-based fisheries management is on their routine agenda. Most of them have bits and pieces here and there, but a holistic framework is usually not in their mind nor in fact available. It has been said that EAF is not a scientific undertaking to be run by scientists, but rather a management process involving authorities and other stakeholders, where the aim is to manage certain human activities rather than the ecosystem itself. However, for a successful EAF, there is need for well-founded scientific inputs so, unless scientists widen their scope and take this task as a part of their normal routine, they will not provide the necessary basis for authorities and stakeholders.

Scientists need to be prepared and get acquainted with this new world. At the Marine Research Institute, Reykjavik, this is being realized and a pragmatic approach to our current single-stock fish assessments is under development. Rather than waiting for a full-fledged EAF system to operate, the choice has been made to address these questions in a wider context than in the past within the present framework.

H. ROUTINE EAF SCIENTIFIC INVENTORY

For each species and stock that is assessed, the aim is to map relevant information both for research and management purposes, including the quality and nature of the assessment techniques used and the effects of the given fishery on the target stock. Further, the effects of the fishery in question with respect to discards of target and non-target species by gear and area will be mapped, both the potential effects of the fishery in question on the physical environment by area and the potential effects of the fishery in question on different ecosystem components or species/stock complexes.

Also when relevant, multi-species considerations will be noted, and special attention will be given to potential effects of environmental changes on the target stock in question, then one would routinely allow for some special management considerations, where they may seem needed.

All these additional ecosystem considerations would cast light on aspects that are relevant for EAF. This would be reflected in the assessment work itself, and in future plans of investigations. In addition to conventional advice to authorities on recommended TACs, a qualitative statement on important or relevant issues in ecosystem context would follow, that would put the advice into a wider EAF context than conventional advice.

I. NATURE AND QUALITY OF ASSESSMENT METHODS

It is of some importance to know the nature and quality of the assessment made for the stock in question, since it can have consequences for interpretation of the results. Thus there is a major difference between assessments based on wealth of high-quality data and advanced assessment techniques and assessments of stocks in data-poor or no-data situations. Stocks may be assessed with the help of age-based techniques and managed on the basis of a well-defined long-term management strategy; they may be assessed with age-based techniques or length-based techniques and catch data, and managed on an ad hoc basis. And finally, in data-poor situations, one would normally require special caution and notation of this would be relevant in this context.

J. EFFECTS OF FISHERY ON TARGET STOCK, DISCARDS AND INDIRECT MORTALITIES

In this approach, the assessment scientist would first make note of the effect of the specific fishery on the target stock, such as a conventional single-species consideration, where the level of impact would be noted on a qualitative scale. Apart from population size, special attention would be given to population and genetic structure, reproductive capacity and geographic range. Is there an estimate available, is it monitored regularly? And if there is no estimate or limited/no data available, is this relevant or of no concern/apparent importance? And finally, is there need

for actions to be taken, for example, conduct of a new or improved assessment, or are there management measures that have not been properly implemented or advice not followed?

The same questions would be raised with respect to discards of target species and non-target species that result from the fishery of the target species. As with the effects on the target stock, one would here need to examine the discards and other factors of ecosystem importance on an area basis, and possibly for different fleets and fishing gear. Similarly, indirect mortalities of target and non-target species would need to be examined. This could involve fish escaping through mesh or off hooks, or fish escaping under the fishing gear, such as in trawl fishery. And again we would note assumed level of impact, availability of estimates and monitoring series, and whether there is specific need for actions to be taken.

K. EFFECTS OF FISHERY ON ECOSYSTEM COMPONENTS AND PHYSICAL ENVIRONMENT

It will also be relevant here to ask questions that traditional assessment scientists would not ask – is the fishery for the given species affecting specific ecosystem components, species/stock complexes or communities? Here one would examine benthic and zooplankton communities, seabirds, marine mammals and fish communities. Is the exploitation of the target species affecting the livelihood of other biological resources, for example, owing to lesser predation or competition or is in case the target species is an important food item for other important ecosystem components. We would note to what extent such effects can be assessed, whether studies are being conducted into this, and whether there are any indications as to whether the impact is low or high.

The effects of fishing activities (by fishing gear and area) on the physical environment needs also to be on the check list, for example, fish and benthic habitats such as coldwater corals. Are there seabed maps available and have the potential effects been studied? And what measures are needed and what measures are in place? Here important fish habitats such as spawning grounds of cod (*Gadus morhua*), capelin (*Mallotus villosus*), sandeel (*Ammodytes* sp.) and herring (*Clupea harengus*) are in focus and nursery grounds of cod, haddock (*Melanogrammus aeglefinus*) and redfish (*Sebastes* sp.). Coldwater corals and other benthic life structures have been mentioned above and these and other three-dimensional habitats have potential importance as habitats for juvenile fish and other animal life needing special attention.

L. OTHER CONSIDERATIONS

By this approach, which would be applied for each species caught in a single-species management scheme, we would ask several additional questions about availability of food-web data and modelling. Have models been developed and predictions been made? Also do recent changes in environmental factors call for special attention since our concern is not only effects of human activities on the ecosystem, but also what changes of the ecosystem are taking place that may affect the resources in question. Also, some operational factors may be a cause of concern, such as sudden market incentives or technological shifts that may influence the basis and interpretation of our assessments. These need to be mapped as well in an ecosystem context.

M. CONCLUSIONS

The ecosystem approach to fisheries is an opportunity to manage human activities, particularly fishing activities, more successfully than has been achieved up to now. It aims at securing growth and sustainability of the fish stocks and their environment in the long term. It contributes to securing biodiversity and ecosystem health. But it requires knowledge and understanding of the nature of the ecosystem and its dynamic interactions, and much more commitment and research than at present. This may require some sacrifices in the short run, while it beyond doubt will be beneficial in the long term. So it is important to continue developing EAF methodology, objectives, scientific criteria and indicators to be used in a full-fledged holistic and cross-sectoral approach.

Until such time that we have the perfect scheme in hand, each sector may choose to develop methods and means to implement this new broader approach. A broadened single-species consideration discussed in the present paper may provide a pragmatic approach to move stepwise forward in this respect. Broadening the portfolio of items to be addressed by classical assessment scientists will help in integrating the concept into the institutional culture, and prepare and motivate the people, including the scientists, that need to be involved in the future work. We need to understand that an inventory of this kind will reveal that much of the information needed is not available and it will take a prolonged period of time and great resources to collect these. But the most important data deficiencies will be identified and appropriate sampling programmes can be initiated. Thereby one would gradually be moving from qualitative ecosystem considerations towards a more developed quantitative scheme of EAF.

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PART THREE
B. LESSONS LEARNED FROM IMPLEMENTATION OF ECOSYSTEM APPROACHES AT THE NATIONAL LEVEL IN DEVELOPING STATES

XIII. ECOSYSTEM APPROACH IN THE RESEARCH AND MANAGEMENT OF THE CHILEAN FISHERIES [19]

Introduction

Research aimed at fishery resource management in Chile has been coordinated for the last 12 years by two governmental organizations: the Fishery Undersecretary (Subsecretaría de Pesca) and the Fishery Research Fund (Fondo de Investigación). Although Chilean fishery management policies do not explicitly consider an ecosystem approach, this concept has been applied to some practical examples.

In terms of developed research, it should be noted that the ecosystem approach to the analysis of important fishery resources in Chile is recent and has been aimed largely at the use of trophodynamic models that attempt to describe the abundance changes observed in some resources. Nonetheless, and in spite of the value of these contributions, two main problems exist: the imbalance in available knowledge and the number of suppositions that must be considered.

A. INFORMATION COLLECTION PROGRAMMES

The Chilean fishery industry began to grow in importance over 40 years ago and has been accompanied by the collection of information, which is subjected to increasingly demanding standards in terms of the quality of the information. In this sense, three primary sources stand out:

(a) The National Fishery Monitoring Programme (Programa de Monitoreo de las Pesquerías Nacionales), historically developed by the Fishery Support Institute (Instituto de Fomento Pesquero), covers the sampling and analysis of the biological-fishery attributes of over 20 target species and gathers information related to the diversity of accompanying fauna;

(b) The Scientist Observer Programme (Programa de observadores científicos), recently initiated, attempts to formalize access to private biological-fishery information, as well as to provide a protocol for collecting information on target species and accompanying fauna;

(c) The Assessment Surveys and Research Fishing Programme (Programa de cruceros de evaluación directa y pescas de investigación) details the quantitative characteristics of the target species and has generated an interesting quantity of information related to stomach content, thereby providing information related to trophodynamics between species.

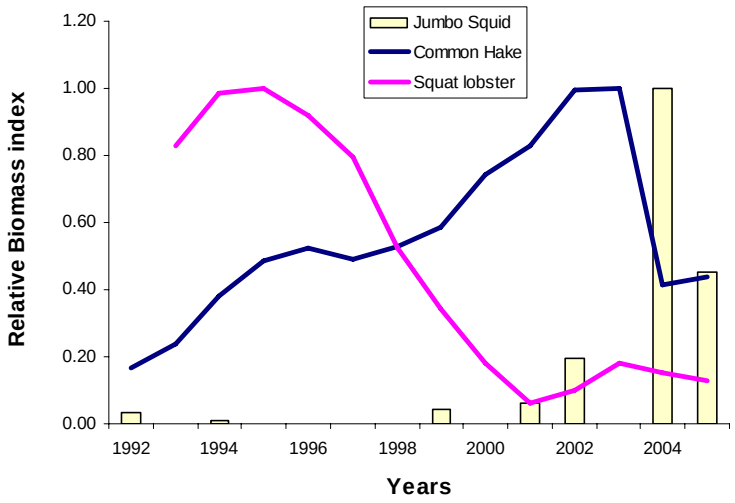
[19] Presented by Cristian Canales, Chilean Fisheries Research Institute, [Instituto de Fomento Pesquero] (see annex).

B. APPLICATION EXPERIENCES

Basic research

Noteworthy university research has been done by scientists at the Universidad de Concepción, including quantitative analyses of trophic interactions between the predator common hake (*Merluccius gayi*) and changes in the abundance of squat lobster (*Pleuroncodes monodon*), shrimp (*Cervimunida johni*), and small pelagic fish like anchovy (*Engraulis ringens*) and common sardine (*Strangomera bentinki*) with the EwE (ECOPATH with ECOSIM) model. More recently, the Fishery Research Fund financed a project in which these same scientists focused on a description of the biomass fluctuations in hake and other species of national interest with respect to the presence of Humbold giant squid (*Dosidicus gigas*); these results will be available before the end of 2006 (see figure 18).

Figure 18
Relative biomass index of common hake, squid and squat lobster



Source: Fishery Support Institute, 2006.

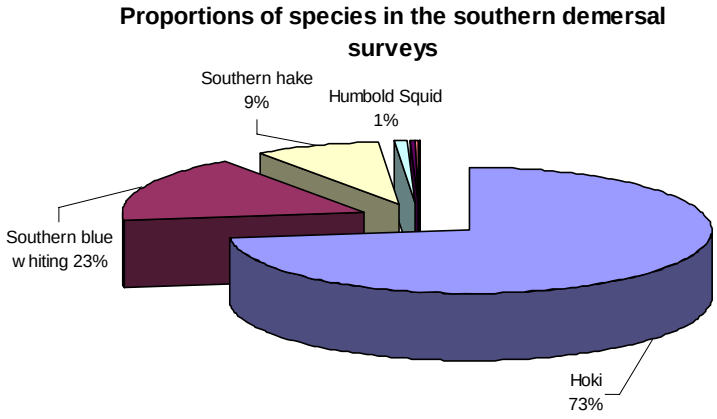
C. APPLIED RESEARCH

Research aimed at fishery management includes the Stock Evaluation and Total Allowable Catch Calculation Programme (Programa de Evaluación de Stock y Cálculo de la Captura Total Permisible), developed by the Fishery Support Institute over a period of 15 years. Although these studies have normally been carried out for individual species, ecosystem elements have been recently incorporated into the studies to establish recommended catch quotas using a multi-species approach. The models are age-structured and formulated from a bayesian perspective.

One example of this is the strong trophic interaction between southern hake (*Merluccius australis*) (predator) and hoki (*Macroronus magellanicus*) (over 98 per cent prey). The latter

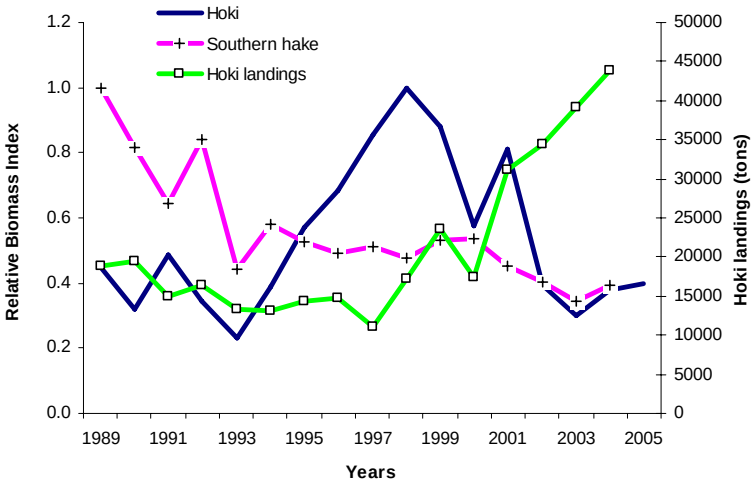
species has, in recent years, achieved a significant commercial value due to the decrease in southern hake. One factor that could explain part of the growth of the hoki population between 1993 and 1998 is decreased predation by southern hake (see figures 19 and 20).

Figure 19
Proportions of species in the southern demersal surveys



Source: Fishery Support Institute, 2006

Figure 20
Relative biomass index of southern hake, hoki, and landings of hoki 1989-2005



Source: Fishery Support Institute, 2006

A historical analysis of southern hake stomach contents shows that this species has a clear preference for hoki by size (figure 21). These elements have been evaluated and considered in

multispecies modelling for these two species in order to establish recommendations for the 2007 catch quotas.

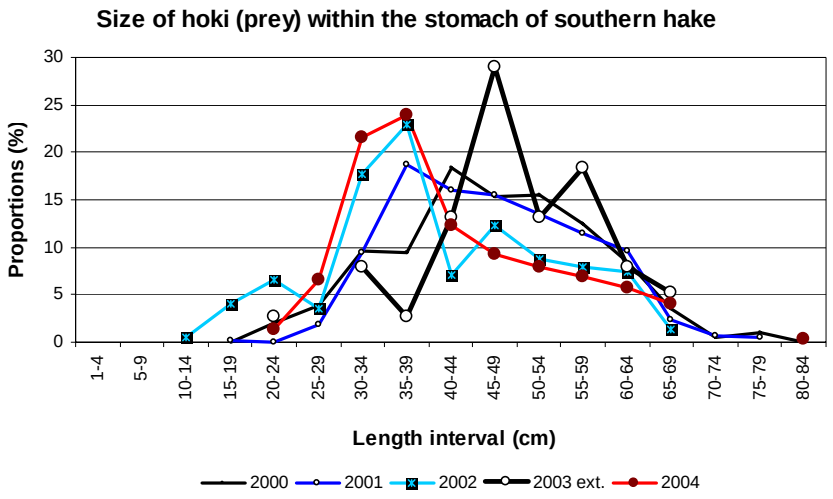
Another analysis was recently done on the common hake stock and its trophic interactions with Humbold giant squid, an important predator of hake after humans (figure 22). According to the stock evaluation model, only the set of deaths by fishing and Humbold giant squid predation can explain the drastic decrease in hake biomass and structure. For 2006, the catch quota recommended by the Fishery Support Institute was determined based on the following factors:

(a) Fishing mortality (potential biological removals);

(b) Expected recruitment;

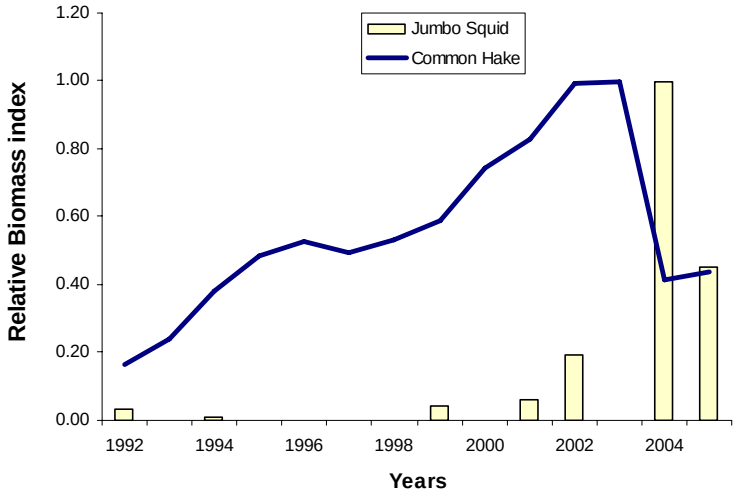
(c) Relative Humbold giant squid presence.

Figure 21
Size of hoki (prey) within the stomach of southern hake



Source: Fishery Research Institute, 2006

Figure 22
Relative biomass index of common hake and squid



Source: Fishery Support Institute, 2006

D. PLANS FOR ACTION AND PROTECTION POLICIES REGARDING BIODIVERSITY

The State's continuing interest in mitigating the effects of fishing on secondary species should be pointed out, and two important plans of action are currently in the process of public consulting:

(a) A protection plan for sharks and rays, as incidental fauna in the industrial long-line fishery mainly targeting swordfish;

(b) A protection plan for marine birds, whose incidental deaths are recorded in the industrial long-line fishery targeting hake in southern Chile.

The main objective of these plans is to prevent, detain, and eliminate both illegal fishing and underreporting.

Along with this, Chile has initiated protection policies for biodiversity through the publication of decrees that regulate the administration and operation of Marine Reserves and the creation of three MPAs, two of which are found in northern Chile and whose administrative plans are being elaborated; the third area is in southern Chile and baseline studies will begin shortly.

E. CONCLUSIONS

Chile faces the challenges of improving the integration of large amounts of information, generating and developing specific research programmes, and joining the efforts that attempt to manage resources based on an ecosystem approach.

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XIV. MICRONESIAN SEA TRADITIONS: PALAU'S MARINE PROTECTED AREAS [20]

Abstract

Surrounded by water, Palauans have developed a life which is inextricably linked with the oceans. We derive food, identity and traditions from our relationship with the ocean. The long-standing success of this symbiotic relationship is based on responsibility that each Palauan is taught from childhood that they are caretakers of the sea.

Prior to the El Niño event which killed much of our soft and hard coral, Palau had been unexposed to such widespread devastation. Seeing the corals die, knowing that we could not stop it made many Palauans want to give up their role as caretaker. We were on the verge of losing heart, especially since once the corals died many of the fish also left, and with them a great deal of our livelihood. This was a clear example of the dramatic, cascading effect that a small change in a single part of the ecosystem can have on all other parts. However, we went back to our roots and saw building on traditional approaches with modern scientific advances as the way forward to crafting effective measures to save our oceans.

Palau's practical experience with the ecosystem approach extends back thousands of years. The traditional practice of *bul* is an important example. *Bul* involves the Council of Chiefs placing reef areas off limits to fishing during known fish spawning and feeding periods. This respects vulnerabilities in the ecosystem while ensuring that there will be robust fish to catch during other times of the year.

This traditional *bul* system has become the basis for Palau's network of protected areas and its new Protected Area Network law. Micronesia is home to most of the world's coral biodiversity -- Palau alone has 1,300 species of fish and 700 species of corals across its islands. Few know these species and waters as well as the Palauan fishermen who have grown up in them. The importance of local perspective thus is self-evident when considering what areas to set aside.

Palau has 21 nationally-designated protected areas and intends to add more. The Protected Area Network law looks first to local leaders and their traditional guidance, and then to scientists, to identify vulnerable ecosystems and coordinate the community, national, and international assistance necessary to institute appropriate protection.

The Protected Area Network law is intended not only to respect local ecosystems and meet Palau's commitments under the Convention on Biological Diversity, but is also serving as a model for MPAs across Micronesia. The Secretary-General has reported that small island developing States have among the lowest percentage of areas set aside for conservation and that

[20] Presented by Noah Idechong, House of Delegates, Palau (see annex).

this seriously threatens their ability to meet Millennium sustainable development goals. This is not the case though in Micronesia where Palau's President Tommy E. Remengesau Jr., in partnership with The Nature Conservancy, has formed a challenge to the world to follow Micronesia's example of setting aside 30 per cent of near-shore marine, and 20 per cent of forest ecosystems for conservation by 2010. Although the focus of these protected areas is decidedly local, we simply cannot achieve these goals without international assistance.

Palau is also using lessons learned about ecosystem vulnerabilities at the local level to protect itself from threats arising beyond its jurisdiction. Palau is working closely with scientists to find ways to protect its coral reefs from bleaching by global climate change. And while there is much about the deep sea that we do not know, we know enough to understand that everything is connected and that, if left unchecked, it is only a matter of time before the destructiveness of bottom trawling is felt in concrete ways. Palau has banned all bottom trawling within its waters and by any Palauan or Palauan company anywhere in the world. Palauan law also obligates Palau to seek an interim prohibition on unregulated bottom trawling in international waters. Much like the rationale behind the *bul* system, this law seeks to protect deep sea fish when they aggregate around seamounts for breeding and feeding, and are thus most vulnerable.

In Palau it is more than just a saying, "we do not inherit the earth from our parents, we borrow it from our children," it is a deeply held belief. And the Pacific philosophy that the oceans unite us rather than divide us is one which we hope will be borne out in our interactions in the United Nations in the days to come as we seek real solutions for protecting this most precious of resources.

XV. BALI PLAN OF ACTION: SECOND APEC OCEAN-RELATED MINISTERIAL MEETING [21]

Introduction

In the Asia-Pacific region the importance of the ocean and sea and the seriousness of the pressures on these resources are widely recognized. Economic development, particularly in this region, is often closely tied to the oceans owing to the increasing densities of population centres in coastal areas and the dependence of economies on products from the sea. The challenge facing this region is to balance short-term economic development needs against the long-term sustainable marine and coastal habitat and resources so that the range of choice and opportunities available in the future is not diminished by the consequences of present development choices.

In this presentation I will be discussing the document called the Bali Plan of Action (BPA). It is a set of actions agreed by Ministers from the Asia-Pacific Economic Cooperation (APEC) to undertake substantial and concrete steps to balance sustainable management of marine resources and marine environment with economic growth in this region. The Plan was adopted at the Second APEC Ocean-related Ministerial Meeting, held in Bali in September 2005.

A. ASIA-PACIFIC ECONOMIC COOPERATION

The Asia- Pacific Economic Cooperation was established in 1989 to capitalize on the growing interdependence of Asia-Pacific economies. Its aim is to create greater prosperity for the people by facilitating economic growth, intensifying economic and technical cooperation and enhancing a sense of community of the people in the region.

The marine and ocean issues are critical to APEC and to global sustainable development since all together APEC members represent 45 per cent of global population and account for over 75 per cent of the world's capture fisheries, and over 90 per cent of world aquaculture production. The Marine Resource Conservation and the Fisheries Working Groups are the Working Groups in APEC committed to implementing the Bali Plan of Action.

B. SECOND APEC OCEAN-RELATED MINISTERIAL MEETING

Based on the decision made by Ministers at the First APEC Ocean-related Ministerial Meeting, held in Seoul in 2002, the Second APEC Ocean-related Ministerial Meeting was held in Indonesia on 16 and 17 September 2005, and was officially opened by H.E. Muhammad Jusuf Kalla, Vice-President of the Republic of Indonesia. The meeting was co-chaired by the H.E. Freddy Numberi, Minister of Marine Affairs and Fisheries, Indonesia, and Hon. Geoff Regan, Minister of Fisheries and Oceans, Canada, with the theme: "Our Coasts, Our Oceans… an Action plan for Sustainability".

[21] Presented by Tonny Wagey, Agency for Marine and Fisheries Research of Indonesia (see annex).

In total there were 20 economies and official guests participating at the meeting, which was preceded by a Senior Official Meeting from 13 to 15 September. At the Senior Official Meeting, the co-chairs were Dr. Indroyono Soesilo and Ms. Lori Ridgeway of Indonesia and Canada, respectively.

During the Second Meeting, the Ministers and their designates adopted the Bali Plan of Action, which seeks to balance conservation and management of marine resources with regional economic growth. The APEC member economies intend to implement the plan starting in 2006 until 2009. It is expected that the Plan will provide guidance to the work of APEC ocean-related working groups, namely the Marine Resource Conservation and Fisheries working groups, through domestic and regional actions in three key areas, which are:

(a) To ensure the sustainable management of the marine environment and its resources. Ministers stressed the critical need for adequate science and economic information, data, and earth observations on which to base their decisions. They also emphasized the importance of taking an ecosystem-based approach to management to address pollution threats, marine invasive species, marine debris and derelict fishing gear, as well as unsustainable farming and harvesting of ocean resources. Furthermore, Ministers resolved to increase their efforts to strengthen and update fisheries governance and management, including through reform of, and cooperation in, RFMOs;

(b) To provide for sustainable economic benefits from the oceans. Ministers emphasized the need to realize the full potential of oceans for communities, alongside strengthened conservation and resource management. Safe seafood and sustainable aquaculture products also play an essential role in this objective. Ministers underscored the APEC goal of trade and investment liberalization and facilitation, including efforts to enhance trade facilitation and market access for fisheries and fish products. They also pointed out the need for institutional and human capacity building and technical assistance to ensure that all economies in the region share the benefits of ocean resources;

(c) To enable sustainable development of coastal communities. Ministers resolved to raise awareness and engagement of these communities in integrated oceans and coastal management. They also outlined actions to reduce the vulnerability of Asia-Pacific communities to future natural disasters and climatic change, recognizing, in particular, the importance of swift reconstruction of those communities affected by the 2004 tsunami. Ministers also underscored the importance of coastal hazard detection and early warning systems.

At the November 2005 APEC Summit in Busan, Republic of Korea, leaders of APEC member economies endorsed the Bali Plan of Action. Also, the relevant APEC forums, in particular, the Marine Resource Conservation and Fisheries working groups have agreed to undertake an inventory of work done against the Bali Plan of Action and where possible, to identify ways to work closely on common priority issues.

ANNEX

THE BALI PLAN OF ACTION: TOWARDS HEALTHY OCEANS AND COASTS FOR THE SUSTAINABLE GROWTH AND PROSPERITY OF THE ASIA-PACIFIC COMMUNITY

Recognizing that healthy oceans and coasts are particularly crucial for food security, poverty alleviation and sustainable and equitable economic growth as well as environmental and resource sustainability in the Asia-Pacific region;

Mindful of the need for conservation and sustainable management of marine resources, responsible fishing and aquaculture practices, including improved management, enforcement and monitoring, the use of best available science and technology, as well as the need for capacity-building and technology transfer;

Noting the findings of the 2005 Food and Agriculture Organization (FAO) State of World Fisheries and Aquaculture Report, that since the 1950s there has been a consistent increase in the proportion of marine fish stocks classified as overexploited or depleted, underscoring the urgent need for action;

Mindful of the need to enhance public awareness of the importance of oceans and seas, and to better integrate our oceans management activities to promote the sustainability of the marine environment and resources, and of the need to accelerate ocean outreach programmes engaging relevant stakeholders in APEC fora;

Acknowledging the instructions of the APEC Economic Leaders, the guiding principles of the Seoul Oceans Declaration (SOD), and responsibilities under oceans and fisheries instruments, including the United Nations Convention on the Law of the Sea (UNCLOS), the United Nations Fish Stocks Agreement (UNFSA), the FAO Compliance Agreement, the Convention on Biological Diversity (CBD), and the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and commitments in the FAO Code of Conduct for Responsible Fisheries, the World Summit on Sustainable Development Johannesburg Plan of Implementation, internationally-agreed development goals, including those contained in the Millennium Declaration, and commitments through the International Maritime Organization (IMO), the World Trade Organization, the Intergovernmental Oceanographic Commission (IOC), and the United Nations Environment Programme (UNEP); and,

Taking into account APEC's basic principles *inter-alia,* of cooperation, voluntary participation, mutual respect, flexibility and open regionalism;

We, the APEC Ocean-related Ministers, reaffirm our commitment to progress the 2002 Seoul Oceans Declaration by taking, subject to available resources and capabilities, substantial and concrete steps to balance sustainable management of marine resources and the marine environment with economic growth.

We, therefore, are determined to work domestically, regionally, and internationally, in the near to mid-term (2006-2009), towards:

I. Ensuring the sustainable management of the marine environment and its resources;

II. Providing for sustainable economic benefits from the oceans; and

III. Enabling sustainable development of coastal communities.

We commit to reporting regularly on progress on the implementation of these actions, domestically and within APEC, and to strengthen the exchange of views and information with other related APEC fora and related regional and international organizations, in view of identifying overlaps and joint programmes.

I. ENSURING THE SUSTAINABLE MANAGEMENT OF THE MARINE ENVIRONMENT AND ITS RESOURCES

To achieve this goal, it is necessary to: a) understand oceans, seas and coasts; b) manage the marine environment sustainably; and, c) manage living resources sustainably.

I.a. Understanding oceans, seas and coasts

A clear and comprehensive understanding of the oceans, seas and coasts will enable APEC member economies to accurately assess their potential and to manage them appropriately. To these ends, we are determined to carry out the following concrete actions:

Oceans observations and data collection

A better understanding of the nature and functions of the oceans, seas and coasts and resources requires capacity and cooperation to collect and share the necessary information for informed decision-making.

(a) Build the capacity of APEC economies to conform to the FAO Strategy for Fisheries Status and Trends Report, and increase the number of APEC economies providing comprehensive data on fisheries to relevant RFMOs, including reporting on the impacts of fishing;

(b) Strengthen regional research and data-sharing partnerships for Pacific and Indian Ocean in-situ observations to enhance global observations in the oceans and coasts;

(c) Encourage the relevant APEC economies to participate in the Group on Earth Observations and carry out the Global Earth Observation System of Systems (GEOSS) implementation plan;

(d) Increase technical cooperation, assistance and capacity building to enable relevant APEC members to implement the Global Ocean Observing System;

(e) Promote more active implementation of open, free and unrestricted, and at or near real-time sharing of relevant observational data for predictions, forecasts, watches and warnings, consistent with international obligations and domestic legislation;

(f) Further develop the Ocean Models and Information Systems for APEC Region as part of a regional contribution to GEOSS;

(g) Promote the collection and sharing of information on the effects of climatic changes, including changes in sea levels and potential impact in the region;

(h) Exchange research and information on ecosystems to ensure conservation and sustainable management;

(i) Exchange research and information on those marine invasive species posing a risk to biosecurity in the Asia-Pacific region;

Understanding the value of the marine sector

A better understanding of the short-term and long-term market and non-market value of the marine sector would better enable stakeholders and decision makers to achieve sustainable, integrated marine management.

(j) Study the market and non-market value of the marine environment and marine industries in the Asia-Pacific region, including by undertaking research, communication and information exchange on marine activities.

I.b. Managing the marine environment sustainably

Sustainable management of activities in the marine environment within the Asia-Pacific region should be aimed at improving the condition and productivity of marine and coastal ecosystems. We commit, where appropriate, to undertake the following actions:

Ecosystem-based management

Sustainability of the environment is achieved through a holistic approach, whereby ecosystems are identified and managed as units with a range of interdependent components. There is a need to better understand these systems and manage the impact of human activities on them.

(a) Develop an agreed set of factors to be applied in defining marine ecosystems in the Asia-Pacific region, and establish a key set of variables to monitor and to assess changes in these ecosystems;

(b) Initiate the identification of ecologically and biologically significant areas and apply, as appropriate, area-based measures, such as marine protected areas, consistent with international law and based on best available scientific information, to manage and conserve these areas;

(c) Increase sharing of best practices on the roles and function of the business and private sectors and communities in the sustainability of marine environment, and promote their involvement;

(d) Improve understanding and management of the impacts of human activities, including fishing practices and aquaculture, on environmental health and productivity;

Marine pollution

Pollution in a variety of forms (i.e. physical, chemical and biological), presents a direct threat to the health and productivity of the oceans, seas and coasts and requires specific action to avoid and minimize the negative effects.

(e) Encourage relevant APEC economies to reduce land-based sources of marine pollution, both domestically and regionally, by implementing the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), and supporting its advancement through participation in the 2nd Intergovernmental Review of the GPA in China in 2006;

(f) Study, in cooperation with UNEP GPA, the economic drivers that contribute to land-based sources of marine pollution;

(g) Support international and regional cooperation, consistent with international obligations, on the prevention and control of sea-based pollution of the marine environment from various sources including oil spills and discharges from vessels;

(h) Support efforts to address derelict fishing gear and derelict vessels, including the implementation of recommendations from research already undertaken in the APEC context;

(i) Identify ways to: analyse ocean circulation, wind and drift patterns in the Asia-Pacific region, areas of accumulation and likely impacts; improve understanding of the harmful effects and costs of marine debris; improve understanding of impediments to proper disposal and recovery; and determine focal points to compile and disseminate member economy expertise and information and create practical guidelines, in cooperation with FAO and other relevant bodies.

Marine invasive species

Marine invasive species pose a threat to the region’s marine species, ecosystems, and economy. There is a need to take appropriate action to limit introductions of marine invasive species and to further develop frameworks to manage incursions.

(a) Continue to develop and implement the Regional Management Framework for APEC Economies for Use in the Control and Prevention of Introduced Marine Pests, specifically in the support of the establishment of a network and capacity-building;

(b) Promote early ratification or adherence, as it is appropriate for the economy, to the IMO Ballast Water Convention and prepare for the requirements of the IMO Ballast Water Convention, including through investigation of a coordinated regional approach to marine

invasive species in the Pacific Basin, with the involvement of IMO, FAO, APEC, South Pacific Regional Environment Programme, Permanent Commission of the South Pacific and other relevant organizations;

(c) Reduce introductions of marine invasive species through all vectors, by increased training of officials to prevent and manage marine invasive species and to implement domestic, regional and international requirements; and cooperation to establish scientific networks and information exchange;

(d) Increase the communication among APEC fora relevant to addressing marine invasive species;

Coral reefs and other vulnerable areas

Because marine and coastal features, including shallow and deep water coral reefs, mangroves, seagrass beds, wetlands and seamounts, serve particularly valuable roles in the maintenance of marine productivity and biodiversity, sustaining coastal integrity, and are important in the socioeconomic and cultural development of coastal communities, special effort is required to maintain these systems.

(e) Improve the conservation of vulnerable areas by: managing activities having a destructive impact on these areas and associated species, based on the best available scientific information; increasing monitoring and research; and enhancing local management, as appropriate, to maintain environmental and economic benefits;

(f) In particular, support the efforts of International Coral Reef Initiative, and International Coral Reef Action Network and other domestic and regional initiatives to ensure coral reef conservation, including by decreasing marine debris and addressing destructive practices such as reef bombing and cyanide fishing;

(g) Improve, through education and outreach efforts, public understanding of: the importance of corals, sea grass beds and mangrove areas to the overall marine ecosystem and to sustaining economic benefits; and, how to avoid degradation;

(h) Encourage member economies to develop their own sustainable coastal policies and integrated coastal management plans, to accommodate the conservation and protection of those vulnerable areas;

(i) Support international and regional efforts on the protection of wetlands and the promotion of wetland awareness.

I.c. Managing living resources sustainably

Managing resources sustainably is an integral component of the process towards achieving a healthy and productive marine environment. Accordingly, we commit, where appropriate, to undertake the following actions:

International fisheries governance

The shared nature of the oceans and their resources has resulted in a variety of multilateral instruments (i.e. regimes, institutions and norms) that represent the fundamental standards and means for cooperatively and sustainably managing fisheries resources. It is important that such instruments are supported.

(a) Increase the number of APEC economies that ratify, or adhere to, UNCLOS, UNFSA, FAO Compliance Agreement, and effectively implement provisions domestically and in RFMOs in which they are a member;

(b) Increase the number of APEC economies that are a party to, or a cooperating non-member of, all relevant RFMOs, and cooperate in establishing new RFMOs, where gaps exist;

(c) Increase the number of APEC economies that implement the FAO Code of Conduct for Responsible Fisheries, Strategy for Status and Trends, and International Plans of Action on Seabirds, Sharks, Fishing Capacity, and Illegal, Unreported and Unregulated (IUU) fishing;

Sustainable fisheries and aquaculture management

Fisheries resources contribute not only to food security and local livelihoods but they support widespread commercial activity and are a key economic driver of the region. Dedicated efforts to ensure the long-term sustainability of these resources is of fundamental importance.

(d) Engage in fisheries management reform, where appropriate, including through RFMO reform, by advocating the application of an ecosystem approach to fisheries management, improving decision-making processes to reflect a precautionary approach, ensuring capacity does not exceed long-term resource sustainability, enhancing monitoring, control and surveillance (MCS) programmes, and establishing adequate sanctions to achieve deterrence;

(e) Strengthen efforts to combat IUU fishing including by pursuing the use of at-sea, port-state and trade-related measures, in accordance with international law, as key compliance tools, through APEC capacity-building and sharing of best practices, and strengthen efforts to collaborate through MCS regimes and the MCS Network;

(f) Identify mechanisms to better manage fishing capacity, such as through projects that facilitate the sharing of APEC economy experiences in fishing capacity reduction and adjustment, to help ensure a balance between such capacity and long-term resource sustainability;

(g) Investigate the role and contribution of data collected by GEOSS to achieving sustainable fisheries;

(h) Support capacity-building and market-based conservation tools for live reef fish, including codes of conduct for sustainable trade in reef food and ornamental fish and measures, as appropriate, for eco-labeling of reef fish;

(i) Assist APEC economies with implementing measures to reduce by-catch resulting in unintentional mortality. These include potential projects on capacity building and technical assistance to reduce by-catch and mortality of species incidentally caught, including marine turtles, in fisheries operations, by demonstrating the benefits of mitigating technology;

(j) Develop programmes to help developing economies contribute to marine turtle conservation based on FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations as well as to help implement, as appropriate, the Indian Ocean and South-east Asia Turtle Memorandum of Understanding, and the Inter-American Convention on the Protection and Conservation of Marine Turtles;

(k) Develop the capacity of APEC economies to implement domestic plans of action for shark conservation and management;

(l) Develop a better understanding of the interaction between climate and fisheries in the Asia-Pacific region;

(m) Improve the protection of critical sites for the replenishment of fisheries, such as spawning and aggregation sites;

(n) Develop an APEC strategy on sustainable aquaculture;

(o) Support efforts by APEC economies to cooperate with FAO to improve knowledge of deep sea fisheries species.

II. PROVIDING FOR SUSTAINED ECONOMIC BENEFITS FROM OCEANS

It is crucial that APEC member economies develop effective and practical steps to realize the full economic potential of the ocean resources of the region by striving to achieve the APEC goals of trade and investment liberalization and facilitation, taking account of conservation and sustainable management of living marine resources. Institutional capacity-building and technical assistance is needed at all stages of the production and distribution chain. Hence, we commit to the following actions:

Maximize value from use, production and harvesting

Economic sustainability depends not only on management for resource sustainability, but that economic value added for economies from the use of such resources is fully enabled.

(a) Undertake further work to improve understanding and management of impacts of aquaculture on environmental sustainability, to secure consumer confidence in aquaculture products, an emerging issue both domestically and regionally, and to facilitate aquaculture's sustainable contribution to coastal communities, wild stocks and food security;

(b) Launch the Aquaculture Network of the Americas and implement its proposed Action Plan, in cooperation with the FAO;

(c) Improve production and post-harvest practices by harmonizing standards to ensure healthy and safe seafood products;

(d) Improve traceability of fish and fish products;

(e) Reduce and eliminate corruption that undermines sustainable fisheries management and fair trade in fisheries products;

(f) Promote the use of voluntary initiatives such as certification schemes, consistent with international standards, including FAO eco-labelling standards, as a complement to mandatory measures;

(g) Minimise fisheries discards and wastage in order to maximise economic benefits from fisheries and aquaculture;

(h) Reduce and eliminate maritime crimes to ensure the maritime safety of fishing and navigation;

Trade facilitation and market access

Efforts to improve trade and access to markets of fish products are necessary to maximize sustained economic benefits from trade.

(i) Support the World Trade Organization/Doha negotiations, including those related to market access for fish and fishery products, and fisheries subsidies;

(j) Build the capacity of the fisheries sector of APEC economies as a matter of highest priority, to adapt to the results of World Trade Organization negotiations;

(k) Undertake stocktaking of existing commitments regarding fisheries and fish products in free trade agreements and regional trade agreements in the Asia-Pacific region and related cooperation agreements to complement broader APEC Review efforts overall;

(l) Enable greater market access for the products of small and medium enterprises, small-scale fisheries, and aquaculture;

(m) In accordance with international law, avoid the use of discriminatory practices and obstacles to trade for fish and fish products;

(n) Ensure that health and safety standards and practices for fish and fish products are transparent, non-discriminatory and based on best scientific information.

III. ENABLING SUSTAINABLE DEVELOPMENT OF COASTAL COMMUNITIES

Healthy and productive oceans and coasts underpin the wellbeing of coastal communities, and are more resilient to human and natural impacts than degraded ecosystems. Cognizant of the human, economic and environmental impacts of climate variability and natural disasters (in particular the 26 December 2004 Indian Ocean Earthquakes and Tsunami), we recognize the need for swift rehabilitation and reconstruction efforts to rebuild sustainable coastal economies in affected regions. In order to mitigate the effects of future hazards and climate extremes on society, we underscore the need for all future coastal development to be in accordance with the principles of sustainable development, disaster risk management and integrated coastal zone management. We, in a practical way, are determined to carry out the following specific measures:

Enabling integrated management

Working towards integrated coastal zone and watershed management to meet community needs while sustaining ocean health.

(a) Develop outreach tools that would increase the awareness and engagement of coastal communities' in various functions such as monitoring and conservation of the coastal environment;

(b) Identify the various roles and functions of fishing communities, including the role of women, in conserving and restoring the marine environment;

(c) Encourage coastal communities to contribute to environmental conservation through beach-cleaning, tree-planting and maintenance of tidal and aquatic plant-beds;

(d) Promote best practices in integrated oceans and coastal management approaches;

(e) Advance regional capacity to address pressing marine resource use and coastal hazards issues by promoting a domestic and regional comprehensive approach that includes research, outreach and education through government, community and academic partnerships;

(f) Reduce the adverse impacts of tourism on marine resources and the environment, including by promoting sustainable marine ecotourism;

Hazard mitigation

Increasing knowledge and the coordination of information is essential to improve the prediction of and preparation for hazards and climate extremes.

(g) Increase coordination to fulfil responsibilities to implement the IOC's end-to-end tsunami warning system, including contingency planning;

(h) Sustain and expand as required multi-hazard capabilities for disaster reduction at domestic, regional and international levels, including the use by APEC economies of the forthcoming All-Hazards Forecast and Warning Compendium that is a product of the June 2005 APEC/United States Workshop in Hawaii;

Post-natural disaster rehabilitation and planning

It is important to ensure the swift rehabilitation and reconstruction of affected coastal communities and their economies, and build capacity to mitigate the impact of possible future events.

(i) Enhance the readiness of coastal communities for possible future tsunamis by increasing coordination with APEC Task Force on Emergency Preparedness and other relevant APEC fora, and increasing the use of expertise of the International Tsunami Information Center through the International Coordination Group for the Tsunami Warning System in the Pacific; and the Indian Ocean Tsunami Warning System;

(j) Re-establish income-generating activities of affected coastal communities, including re-establishing aquaculture and fishing effort, ensuring sustainability, and support coastal zone environmental rehabilitation;

(k) Investigate the use of an on-line database to allow APEC economies to update and view details of all tsunami-related projects, programmes and activities;

(l) Develop integrated coastal zone management plans that anticipate and plan to mitigate the impact of hazards and climate extremes, allowing coastal communities to adapt and mitigate the affects.

XVI. SEA USE PLANNING IN THE GULF OF CALIFORNIA: A TALE OF AN ECOSYSTEM-BASED MANAGEMENT PROCESS [22]

A. General aspects related to ecosystem-based management

Mexico has adopted the concept of EBM in managing watersheds, river-basins, estuaries and coastal seas through the application of integrated and adaptive management approaches to work with several important issues such as pollution of coastal and marine habitats, loss of biodiversity and habitats, depletion of exploited natural marine resources, coastal land erosion and land reclamation and many other issues related to social, economic, political, cultural and ecological features in the country.

To facilitate effective cooperation for conservation and enhancement of Mexico´s oceans and coastal ecosystems, the federal Government is determined to participate actively together with civil society to achieve sustainable development and increasing government accountability regarding the enforcement of environmental laws. In such context Mexico is moving along with several key policy principles:

(a) Sustainability;

(b) EBM;

(c) Adaptive management;

(d) Precautionary approach;

(e) Multiple use;

(f) Integrated approach;

(g) Transparency;

(h) Accountability;

(i) Governance.

All of these are aimed at enhancing the participatory process among government at all levels, society, private entrepreneurs and NGOs. Both EBM and integrated management approaches are the key components ideal to achieve environmental sustainability.

[22] Presented by Porfirio Alvarez Torres, Ministry of Environment and Natural Resources, Mexico.

B. EXAMPLES OF APPLICATION OF ECOSYSTEM-BASED MANAGEMENT IN MEXICO

Application of EBM stresses the importance of environmental issues as a crosscutting sector. Currently, Mexico has directed its efforts to assembling the ecosystem-based approach, through the Sea Use Planning initiatives in the Gulf of California (published June 16, for public consultation), to starting a new initiative for the Sea Use Planning of the Gulf of Mexico and the Caribbean Sea, to working on the Transboundary Diagnostic Analysis of the Gulf of Mexico as a LME, and soon will be working in the central-south Pacific side of Mexico.

C. ECOSYSTEM-BASED MANAGEMENT WITHIN THE NATIONAL ENVIRONMENTAL POLICY FOR THE SUSTAINABLE DEVELOPMENT OF OCEANS AND COASTS

To enhance environmental information on marine ecosystems and to improve the intersectoral and institutional framework and arrangements the "National Environmental Policy for the Sustainable Development of Oceans and Coasts: Strategies for its Conservation and Sustainable Use" was recently developed.

Some of the major coastal and oceanic economic activities are: (a) fisheries, aquaculture, and mariculture; (b) tourism; (c) industrial activities; (d) energy production-related activities; and (e) ports and transportation activities. However, they are in an enduring competition for availability of natural resources, and space utilization, inducing a permanent tension among uses, users and between environmental conservation and economic development objectives.

Main coastal and marine priority issues are: (a) decrease of the fisheries catch; (b) water pollution; (c) habitat deterioration and habitat loss; (d) biodiversity loss; (e) visual quality impact; (f) increase of solid and liquid wastes due to urban growth; (g) loss of public recreation areas; and (h) impacts on public health among others. Each of these factors can be used as indicators for identifying unsustainable natural resources uses. The overlapping of economic activities and conservation areas, and the resultant consequences, emphasize the need for a coordinated management of the ocean and coastal zones in order to guarantee a sustainable development of both realms.

Among existing environmental tools available to integrate all type of economic activities, Mexican law provides an appropriate framework related to sea and land use planning which is applicable in both terrestrial and coastal and marine areas.

Box 1
Existing environmental policy instruments

- Environmental planning
- **Land and sea use planning**
- Natural protected areas
- Economic instruments
- Environmental regulations on infrastructure for human uses
- Environmental impact assessment
- Mexican official standards on environmental issues
- Environmental audits
- Research and education

Such tools represent a way to integrated policy for oceans and coasts where each federal agency usually works in isolation, considering only their duties and faculties given by the Organic Law. Thus the Sea Use Planning framework becomes the ideal mechanism to build upon concurrent sector plans and under the view of National Constitution and all related environmental laws.

The recently published "National Environmental Policy for the Sustainable Development of Oceans and Coasts: Strategies for its Conservation and Sustainable Use", covers the following items:

(a) Legal and institutional frameworks;

(b) Environmental policy tools and instruments;

(c) Ecosystems and biodiversity;

(d) Sectoral activities and human settlements;

(e) Governance and public participation;

(f) Information systems (capacity-building: research, development, education and public awareness).

The Mexican Federal Government marked its determination to move towards the alignment of economic growth and sectoral development accompanied by a continuous improvement in environmental performance, aided with streamlined actions among sectors that use ocean and coastal natural resources.

The objective of this oceans policy is to promote sustainable development while achieving enhanced environmental and life quality of coastal communities, fostering a pollution-free environment, as well as protecting and conserving of coastal and marine heritage. This policy

acts as a catalyst for sea and coastal use planning activities in an area of high environmental and economic complexity and certainly represents a tremendous challenge.

Box 2
Main objectives of the National Environmental Policy for Oceans and Coasts

- Promote governance and improve sustainable use of coastal and ocean resources
- Strengthen critical habitats
- Promote adequate ocean and coastal use planning
- Promote sustainable development of coastal areas
- Strengthen control of land-based sources of pollution

D. WHY THE SEA USE PLANNING PROCESS?

This tool provides an opportunity to build upon a shared vision for the sustainable development of the Gulf of California. This process helps in the identification of marine and coastal zones with particular aptitude for development of economic activities and in the reduction of environmental impacts. It provides a framework of certainty for entrepreneurs and investors and helps to prevent potential sectoral conflicts.

Box 3
Sea Use Planning in the Gulf of California
Objectives and benefits of the process

- Identifies pattern (mapping) of distribution of all sectoral activities
- Reduces possibility of environmental and social conflicts
- Encourages productive sectors towards proper areas in the region to prevent and reduce environmental impacts
- Promotes the equilibrium of all productive activities to protect the environment
- Protects natural heritage
- Provides certainty for investment
- Reconsiders the process of occupation and use of the territory
- Defines the intensity of use of the territory
- Promotes alternative solutions to sectoral activities
- Supports informed decision making in other environmental instruments

E. STAGES IN THE SEA USE PLANNING PROCESS

The sea use planning process in the Gulf of California identifies:

(a) Priority attention areas;

(b) Sectoral incompatible activities within the same area;

(c) Areas with specific feasibility to develop particular economic activities;

(d) Guidelines and strategies for ocean and coastal use;

(e) Proper interaction of government programmes and sectors.

Figure 23
Stages in the sea use planning process

F. MAIN CONSIDERATIONS OF ECOSYSTEM-BASED MANAGEMENT AT THE OPERATIONAL LEVEL

At the operational level, there are four pillars that clearly promote the application of EBM, enhancing inter-institutional coordination to efficiently address current and emerging management and planning issues regarding oceans and coastal zones:

(a) Enhance the quality of life of coastal communities;

(b) Promote harmonization between economic and social development and sustainable conservation of ocean marine resources;

(c) Achieve social equity and poverty alleviation; and

(d) Promote sustainable values and ethical appropriation.

In order to ensure EBM applicability in a multidisciplinary and multisectoral way, it is suggested to:

(a) Develop a clear legally binding geographic definition of the coastal zones within States to support EBM;

(b) Build EBM and/or adjust the current national legal framework as appropriate, strengthening institutions and aligning regional programmes within States;

(c) Define the scale of marine-coastal geographic extension where EBM will be applied;

(d) Arrange available scientific data bases in a systematic way;

(e) Promote easy access by the public in order to allow society to track EBM advances and degree of progress so as to facilitate informed decision making;

(f) Strengthen and promote the “marine ecological use planning” method and its integration with the respective coastal-terrestrial region;

(g) Establish a compulsory evaluation of environmental impact assessment of development projects and activities carried out in oceans and coastal areas;

(h) Develop and operate economic and environmental certification instruments;

(i) Define use and exploitation limits for all marine and coastal resources through development planning and harmonization of sectoral activities;

(j) Establish measures to control the introduction of exotic species into coastal and marine ecosystems;

(k) Develop conservation programmes for coastal and marine ecosystems, particularly vulnerable ecosystems and threatened species;

(l) Develop regional programmes to rehabilitate coastal and marine ecosystems and their incorporation into the Sea Use Planning process;

(m) Develop techniques to assess economic value of vulnerable ecosystems;

(n) Use environmental criteria and best available scientific evidence, and the precautionary approach during sectoral planning and management of coastal and marine resources;

(o) Generate a regional planning model for coastal zones, compatible with sustainable development of productive activities and urban development;

(p) Promote planning at the national level of urban and rural development and human settlements along coastal areas;

(q) Strengthen mechanisms to prevent and mitigate natural environmental and human impacts due to productive activities and growth of urban coastal centers;

(r) Improve management of natural resources, law enforcement and surveillance aimed towards development in coastal areas, and enhance accountability;

(s) Enhance accountability and transparency in all Ecosystem Based Management and Integrated Management related processes.

Considering the above-mentioned items, EBM would move forward to implement them commonly along with proper regional marine strategies within developing States to respond to global initiatives such as the World Summit on Sustainable Development, the United Nations Conference on Environment and Development and the Millennium Development Goals as well as to several other ocean-related declarations, such as the Seoul Declaration and the Bali Plan of Action.

Box 4
Major constraints and the way forward

- Adjust current legal framework
- Define common priorities among federal agencies towards oceans and coastal sustainability
- Strength the environmental crosscutting “agenda”
- Move towards sectoral integration
- Establish the National Ocean Policy based on the Environmental Policy for the Sustainable Development of Oceans and Coasts

PART FOUR
INTERNATIONAL COOPERATION TO IMPLEMENT ECOSYSTEM APPROACHES AT THE REGIONAL AND GLOBAL LEVELS

XVII. OSPAR'S DEVELOPMENT OF AN ECOSYSTEM APPROACH [23] [24]

Introduction

The aim of this presentation is to explain how and why OSPAR has adopted an ecosystem approach, to show what such an approach has involved, and to set out the approach being made to make it operational.

At the start, it may help to give a reminder of who we are: the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) has 15 States in the North East Atlantic catchments as its Contracting Parties: Belgium*, Denmark*, Finland, France*, Germany*, Iceland, Ireland, Luxembourg, the Netherlands*, Norway*, Portugal, Spain, Sweden*, Switzerland and the United Kingdom*, together with the European Community*. In addition, the eight countries marked with an asterisk and the European Community have cooperated in the North Sea processes (with some involvement also of Luxembourg and Switzerland), which has acted as a "ginger group" outside the formal framework of international agreements.

A. TOWARDS AN ECOSYSTEM APPROACH

It is important to be clear to what the ecosystem approach is an approach. Some references talk about an ecosystem approach to the management of the marine environment. But in OSPAR it has always been clear that the ecosystem approach is an approach (as the 2003 Ministerial Meeting of the OSPAR Commission made clear) "Towards an ecosystem approach to the management of human activities which may affect the marine environment."

OSPAR has reached this stage by a long process of incremental development. The main stagers have been:

1969 - Bonn Agreement on response to shipping disasters;
1972 - Oslo Convention introduces controls on dumping;
1974 - Paris Convention controls land-based discharges, including offshore installations;
1992 - OSPAR Convention merges and updates, but was still focused on pollution – nevertheless the possibility was introduced to extend obligations and commitments to cover other human activities;
1998 - Annex V covers all relevant human activities – but does not permit OSPAR to adopt measures on fisheries management and gives a preference for IMO action on shipping.

[23] Presented by Alan Simcock, OSPAR Commission (see annex).

[24] This presentation is based upon material agreed by the OSPAR Commission, but the views expressed are those of the Executive Secretary, and are not necessarily those of the OSPAR Commission or of its Contracting Parties.

In these various stages, however, there was no introduction of the concept of the ecosystem approach. The environment as a whole was, of course, important, but more as something that would be affected by the various impacts being considered, than as a guide to what needed doing.

The changes that led to the move to an ecosystem approach were part of a more general change in thinking based on an understanding of the importance of the operation of a whole ecosystem as determining the health of its many components. Important milestones can be noted as:

(a) The United Nations Convention on the Law of the Sea which, by its comprehensive approach, made States think about the interrelationships when they came to implement it;

(b) The lead up to the 1992 Rio Earth Summit, where Agenda 21 proclaimed clearly that the message for proper management of the worlds oceans and seas was "Integration, Integration, and yet more Integration";

(c) The OSPAR 1993 North Sea Quality Status Report, which looked at all aspects of the marine environment of the North Sea, and showed that the main problems were no longer pollution.

Within OSPAR, the Fourth North Sea Conference, held in 1995, considered the problems of fisheries and agreed to summon a special joint meeting of Ministers of the Environment and Ministers of Fisheries. The Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues was accordingly held in Bergen, Norway, in 1997. The Meeting agreed that an ecosystem approach was needed, not merely to the management of fisheries, but to the whole range of human activities which can affect the marine environment. It emphasized the need for: "the development and application of an ecosystem approach which, as far as the best available scientific understanding and information permit, is based on, in particular:

"(a) The identification of processes in, and influences on, the ecosystems which are critical for maintaining their characteristic structure and functioning, productivity and biological diversity;

"(b) Taking into account the interaction among the different components in the food-webs of the ecosystems (multi-species approach) and other important ecosystem interactions; and

"(c) Providing for a chemical, physical and biological environment in these ecosystems consistent with a high level of protection of those critical ecosystem processes."

The statement of conclusions also stressed the need to base this work on the best available scientific understanding and information, and the limitations that lack of good scientific understanding imposed.

These conclusions can be summarized as stressing three themes for an ecosystem approach:

(a) Critical ecosystem processes;

(b) Interactions within food-webs;

(c) A high level of protection of the chemical, physical and biological aspects of the marine environment.

B. DEVELOPING A FRAMEWORK FOR IMPLEMENTING AN ECOSYSTEM APPROACH

These conclusions have informed the thinking of OSPAR. In parallel with this work on fisheries and the environment, OSPAR had been developing six strategies to guide its collective work. Each of these set out long-term, undated, aims, time-constrained immediate goals, and the way in which these objectives would be pursued. The six strategies are:

(a) Hazardous substances strategy;

(b) Radioactive substances strategy;

(c) Eutrophication strategy;

(d) Offshore oil and gas industry strategy;

(e) Marine ecosystem and biological diversity strategy;

(f) Joint environmental assessment and monitoring programme strategy.

The questions that the work on the ecosystem approach raised were whether these strategies, taken together, were consistent and comprehensive. The OSPAR strategies and other international commitments and obligations - like any sectorally based approaches - are partial descriptions of what is needed. Are they mutually consistent? (OSPAR thinks its strategies are - but needs to show it!). And partial descriptions of what is to be done need to integrate with all other policies - especially fisheries and shipping.

But how can such integration be delivered? Action has to be sectoral:

(a) The United Nations Convention on the Law of the Sea sets up sectoral machinery;

(b) National structures are sectoral;

(c) Management of human activities is sectoral.

Nevertheless, the sea is one environment. How do we integrate and show that we are integrating everything?

The overall goal can be stated fairly simply as ensuring that our marine environment is healthy and sustainable. Based on the analysis of what the ecosystem approach entails, and a

characterization of the marine environment (for OSPAR, the Quality Status Report 2000 has fulfilled this role), this means that we need to address three sets of questions:

(a) The cross-cutting aspects:

(i) The critical ecosystem processes – primary production, reproductive success, migration, etc.;

(ii) Threatened and declining species and habitats – like the traditional miners' canary, these highlight what processes are under pressure;

(iii) MPAs – which are poles for crystallizing protection of critical processes;

(b) The full range of the living components of the marine environment:

(i) Phytoplankton;

(ii) Zooplankton;

(iii) Macrophytes (e.g., large seaweeds);

(iv) Benthic species (including shellfish);

(v) Fish;

(vi) Reptiles;

(vii) Seabirds;

(viii) Marine mammals;

(c) The full range of the different human activities:

(i) Fisheries;

(ii) Shipping;

(iii) Minerals extraction (oil and gas, sand and gravel);

(iv) Tourism;

(v) Coastal protection;

(vi) Cables/pipelines;

(vii) Land-based discharges;

(viii) Offshore wind power and other renewable power installations;

(ix) Etc., etc., etc.

All these individual aspects are being addressed separately. The problem is how to put all this together into a consistent, coherent and comprehensive system to protect the marine environment.

C. ECOLOGICAL QUALITY OBJECTIVES AS A MEANS OF SHAPING AN ECOSYSTEM APPROACH

OSPAR had been organizing work since 1990 on the idea of EcoQOs as a means of setting verifiable measures of how we were doing in moving towards our overall goal of a healthy and sustainable marine environment. This work was the natural outcome of the monitoring and assessment process: if you are monitoring and measuring something, then naturally you start asking what the value of the measurements should be, as well as what it is.

By the time of the Fifth North Sea Conference, also in Bergen, in 2002, the work had progressed enough for the Ministers to agree on a North Sea Pilot Project, to show how a system of EcoQOs could be established. The annual meetings of the OSPAR Commission in 2002 and 2003 took up the pilot project as part of OSPAR work, and in 2005 agreed on a *Report on the North Sea Pilot Project on Ecological Quality Objectives* [25].

How can one visualize the ecosystem approach and the contribution that EcoQOs can make? Ecosystems have a natural variability. We cannot specify a single state for any ecosystem. We need to concentrate on the "envelope" within which we can be reasonably confident that the ecosystem is healthy and sustainable. This envelope can be envisaged as a shape joining the points on a series of vectors (each vector representing one of the scales of measurement of the EcoQOs) which are regarded as consistent with a healthy and sustainable marine environment (the analogy of the allium seed-head). Each of these vectors represents one of the dimensions in which ecosystem health and sustainability can be measured.

To implement this approach, we need to identify the measurement scales that we should use. OSPAR has identified nine "ecological quality issues" as the fields within which these dimensions should be sought. These nine issues are:

(a) Reference points for commercial fish species;

(b) Sea mammals;

(c) Birds;

(d) Fish communities;

[25] Ospar Commission, Biodiversity Series, No. 239, 2006, available from www.ospar.org.

(e) Benthic communities;

(f) Plankton communities;

(g) Eutrophication;

(h) Threatened and declining species;

(i) Threatened and declining habitats.

For each ecological quality issue we are then identifying one or more "ecological quality elements" – the dimensions to be measured and the scales on which the dimensions can be measured. For each of these elements, we then have to identify an "ecological quality objective" (EcoQO) – the desired level of that dimension on that scale.

With the help of the International Council for the Exploration of the Sea, we have established a set of criteria that a good EcoQO should meet. A good EcoQO will unite the following qualities:

(a) The EcoQO will have a clear scientific basis, linking it to significant aspects of the quality of a marine ecosystem;

(b) Data on the EcoQO can be collected effectively and economically across the whole range to which it applies;

(c) There is a clear reference level or target against which the data on the EcoQO can be evaluated;

(d) There is general acceptance of the validity of the EcoQO by all relevant stakeholders.

To achieve these qualities, EcoQOs will be better the more that they are:

(a) Relatively easy to understand by non-scientists and those who will decide on their use;

(b) Sensitive to manageable human activity;

(c) Relatively tightly linked in time to that activity;

(d) Easily and accurately measured, with a low error rate;

(e) Responsive primarily to a human activity, with low responsiveness to other causes of change;

(f) Measurable over a large proportion of the area to which the EcoQO metric is to apply;

(g) Based on an existing body or time-series of data to allow a realistic setting of objectives.

To help understand how these principles are applied, it helps to take a few examples:

(a) Illegal oil discharges from ships is a matter of concern. To measure this, the chosen environmental quality element is the proportions of samples of dead or dying guillemots (*Uria aalge*) found on beaches marked with oil. To implement this, it is necessary to establish sampling protocols, judgement criteria, and systems for reporting and evaluating data;

(b) The impact of chemicals on the marine environment is a long-standing concern of OSPAR. To measure our success in this field, one of the chosen ecological quality elements is levels of organohalogens in seabird eggs. To implement this, we need a similar set of implementation processes;

(c) The impact of fisheries on non-target species is a major concern. The chosen ecological quality element is the number of harbour porpoises caught as by-catch as proportion of the estimated population.

These are examples of EcoQOs tied closely to single, specific issues. Another type of EcoQO integrates the effects of a number of human activities on a significant element of the marine environment. Examples of these are the EcoQOs for:

(a) Seabird populations, as an integrator of the effects of all three aspects of the ecosystem approach;

(b) Seal populations, again as an integrator.

So far in the pilot project, we have examined the 21 ecological quality elements proposed in 2002. We have concluded, on closer examination, that two should not be pursued. Ten are well advanced and are to be adopted and applied, but some amendments are needed to the precise formulations of some of them. Nine need much further work. Gaps can be seen - some may be filled with existing work, but we probably need to look in more detail at macrophytes (seaweed), a wider range of pollutants, how to specify objectives for threatened species and habitats, and how to address questions of radioactive substances. The main conclusions are that the EcoQO system is workable. We can define a good ecological quality objective. Some of the original proposed EcoQOs are good – others are not. We need to consider how to extend the system to other parts of the OSPAR area.

One of the most important conclusions is the need for agreement on the implications of missing an EcoQO: Are EcoQOs targets which must be achieved? (That approach has the difficulty that it may not be prudent to adopt such a commitment/obligation before you know what is involved?). Or are EcoQOs indicators, where a miss means that you need to study why it is being missed, and what action that indicates? (That approach has the difficulty that such an objective may not be credible). This set of questions is what we are now working on.

D. CONCLUSIONS

What general conclusions can be drawn from all this work? I would suggest the following:

(a) The ecosystem approach is not a new start: it is rather a way of integrating what we have been doing under international and national obligations and commitments, and showing that what is being done is coherent and comprehensive;

(b) This integration will also show where there are gaps or inconsistencies in what we are doing, and give an impetus to fill or correct them;

(c) The use of EcoQOs can give a clear framework for making the ecosystem approach into something where the state of the marine environment can be measured and the success in delivering the ecosystem approach can be evaluated.

We all want the marine environment to be healthy and sustainable. How best to do it with the resources that can be made available? OSPAR thinks that the ecosystem approach and the use of EcoQOs can help in this.

XVIII. INTERNATIONAL IMPLEMENTATION OF THE ECOSYSTEM APPROACH TO ACHIEVE THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES [26]

Introduction

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) [27], which held its first meeting in 1982, was the first international organization charged with achieving an ecosystem approach to the conservation of exploited stocks, notably krill, as well as the conservation of the wider ecosystem. Since its beginning, CCAMLR has evolved from initially reacting to over-exploitation of stocks, a situation inherited from previously unregulated fisheries prior to the Convention, to establishing the precautionary approach for new and developing fisheries as well as establishing a process for implementing an ecosystem approach, including monitoring and assessments that take account of the ecosystem requirements.

The evolution of CCAMLR and its advisory bodies over its first 25 years provides a strong lesson in what can and cannot be achieved using different management approaches both in terms of how a governing commission can effectively use the best scientific evidence available and what is diplomatically achievable in a regional commission.

CCAMLR has been successful in implementing its ecosystem approach because of the emphasis on the conservation of the marine ecosystem and only permitting rational utilization of marine living resources in the region. Whales and seals are excluded from consideration by CCAMLR except as they may be impacted by fisheries.

The present paper summarizes the evolution of the precautionary and ecosystem approaches of CCAMLR [28] and how it developed operational objectives, data collection programmes and methods for dealing with uncertainty in knowledge to provide a scientific basis for regulating fisheries, including new fisheries, while conserving the marine ecosystem. It also summarizes some of the compliance and enforcement activities being undertaken to provide for effective implementation of the harvest regulations. Lastly, the experience of CCAMLR in its first 25 years is used to describe the important elements required for CCAMLR to be an effective regional management system governing the conservation, including rational use, of marine living resources.

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[26] "Convention on the Conservation of Antarctic Marine Living Resources: implementation of the ecosystem approach on the high seas", presented by Andrew Constable, Australia and Australian Commonwealth Department of Environment and Heritage, Australian Antarctic Division (see annex).

[27] "CCAMLR is a conservation organisation with the attributes of an RFMO… evident in management of toothfish fisheries" CCAMLR XXI – 2002, paragraph 15.2).

[28] Reviewed in Constable, A.J., and others, "Managing fisheries to conserve the Antarctic marine ecosystem: practical implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)", *ICES Journal of Marine Science*, 2000, vol. 57, No. 3; Miller, D.G.M., and others, "CCAMLR's approach to managing Antarctic marine living resources", in *Deep Sea 2003: Conference on the Governance and Management of Deep-Sea Fisheries*, Part 1: Conference Reports, R. Shotton, ed., FAO, Rome, 2005 (FAO proceedings 3/1).

A. THE CONVENTION ON THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

The Convention on the Conservation of Antarctic Marine Living Resources (1980) [29] (hereafter referred to as the Convention) applies to the area south of the Antarctic Polar Front (formerly known as the Antarctic Convergence). Within this zone, CCAMLR endeavours to enable rational use of marine species, excluding whales and seals, while ensuring principles of conservation are maintained. These principles aim to ensure the maintenance of stable recruitment in target species, the maintenance of the ecology of the system, particularly in relation to predators of those target species, and that the ecosystem effects of fishing must be reversible over a fixed period. These principles are contained in paragraph 3 of article II of the Convention, such that:

> "3. Any harvesting and associated activities in the area to which this Convention applies shall be conducted in accordance with the provisions of this Convention and with the following principles of conservation:
>
> "(a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment. For this purpose its size shall not be allowed to fall below a level close to that which ensures the greatest net annual increment;
>
> "(b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine resources and the restoration of depleted populations to the levels defined in sub-paragraph (a) above; and
>
> "(c) prevention of changes or minimization of the risk of change in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem and of the effects of environmental changes, with the aim of making possible the sustained conservation of Antarctic marine living resources."

Article IX provides the means by which CCAMLR can manage fisheries. It includes that CCAMLR must base decisions on the best scientific evidence available, which means that CCAMLR does not need to wait until all science is concluded before making a decision. Decisions pertaining to controls on fisheries are embodied in "conservation measures". States agree to be legally bound by these measures when they become parties to the Convention. Non-binding but agreed principles are often embodied in resolutions. Decisions are made by consensus.

CCAMLR now comprises 24 members and 9 parties; a member is a Party that is active in harvesting or research, contributes financially to CCAMLR and has voting rights. CCAMLR receives advice from a Scientific Committee and standing committees on Implementation and Compliance, and Administration and Finance. A Working Group on Developing Approaches to Conservation (1987-1990) began the task of interpreting the Convention's objectives and providing mechanisms for making ecosystem-oriented decisions rather than concentrating on

[29] The text of the Convention is available at http://www.ccamlr.org/pu/e/e_pubs/bd/toc.htm (the website is also accessible in French, Russian and Spanish).

individual species. Working groups of the Scientific Committee include Fish Stock Assessment, Ecosystem Monitoring and Management (formerly the working groups on Krill and on the CCAMLR Ecosystem Monitoring Programme) and Incidental Mortality Arising from Fishing (currently part of Working Group on Fish Stock Assessment).

B. THE EARLY YEARS: REACTIVE MANAGEMENT

In the first instance, CCAMLR only reacted to the need for conservation measures once there was demonstrable proof, namely, consensus in the Scientific Committee, that those measures were needed. This approach was recognized to fail in the late 1980s-early 1990s following difficulties in curbing fishing activities until stocks were obviously depleted.

During this period, the management of fin fisheries relied on then-existing standard methods for stock assessment and yield predictions based on the principles of the time regarding MSY. Most attention was given to the status of marbled rockcod around South Georgia. Despite the incomplete data set and lack of detailed analyses, there was sufficient evidence to recommend a closure of 12 nautical miles around the main fishing ground in Subarea 48.3, mesh size regulations and a reduction in catches to below the levels caught in the early 1980s. While the first two recommendations were adopted by the Scientific Committee and set into conservation measures by CCAMLR, the recommendation to restrict catches was opposed in the Scientific Committee [30] on the basis that the information and the analyses were incomplete. Although a prohibition of directed fishing for marbled rockcod was established in the following year, this impasse set the tone of discussions for the remainder of the 1980s with the implementation of important measures to protect depleted stocks often lagging behind the majority scientific advice by one to two years. These difficulties in finding scientific unanimity increasingly raised the question: "How should the Commission deal with uncertainty in assessments and advice from the Scientific Committee?" Uncertainties arose from natural variation in stock abundance and large statistical errors in stock assessment, uncertainty in estimates of model parameters, incomplete historical catch records and imprecise submission of recent data. They also arose in the decision-making process generally because of the assessment methodologies available at the time.

The problem manifested itself when the mostly non-scientific Commissioners had to choose between different assessments and their consequences, without detailed knowledge of why the differences arose [31]. Within CCAMLR, the implementation of catch limits, as with any conservation measures, required consensus and often resulted in majority advice from the Scientific Committee for lower catch limits being rejected.

In 1990, CCAMLR endorsed the need for the Scientific Committee to develop a method of assessments that would achieve scientific consensus, such that uncertainty could be

[30] Official documents of the Scientific Committee, *Report of the Third Meeting of the Scientific Committee* (SC-CAMLR-III), Hobart, Australia, 1984.

[31] A typical example is the 1987 assessment of mackerel icefish in Subarea 48.3 where the estimates of yield varied by a factor of 3, in Official documents of the Scientific Committee, *Report of the Sixth Meeting of the Scientific Committee* (SC-CAMLR-VI), Hobart, 1987.

unambiguously and unanimously dealt with in the management of Antarctic fisheries. This signaled a change towards a precautionary approach by CCAMLR. In the following year, the debate on how to manage the krill fishery to protect the pivotal importance of krill in the Antarctic marine ecosystem ended with CCAMLR endorsing the advice of the Scientific Committee "that reactive management - the practice of taking management action when the need for it has become apparent – is not a viable long-term strategy for the krill fishery. Some form of feedback management, which involves the continuous adjustment of management measures in response to information, is to be preferred as a long-term strategy. In the interim, a precautionary approach is desirable and in particular, a precautionary limit on annual catches should be considered." [32] This resulted in the first precautionary catch limit for krill being set in 1991 and the first explicit recognition of the need for precautionary measures prior to the development of feedback management procedures [33].

C. MAKING ECOSYSTEM OBJECTIVES OPERATIONAL AND ACHIEVABLE

Discussions on how to embrace the objectives set out in Article II arose during early meetings of the Scientific Committee [34]. In 1985, CCAMLR was presented with a framework for evaluating management procedures (or strategies) based on simulations that tested whether management measures are highly likely to meet the objectives they are set to achieve [35]. This formed the precursor of discussions in the Commission Working Group on the Development of Approaches to Conservation [36] in which the need to specify the objectives in scientifically measurable terms, known as operational objectives, was discussed, forming the basis for setting objectives for the krill fishery.

A notable consideration in this discussion was that the ecosystem objectives for a given activity are restricted to the potential consequent effects of that activity on the ecosystem rather than endeavouring to specify objectives for the ecosystem as a whole [37].

Operational objectives were initially specified for krill stocks. There are two parts to the objective that need to be met simultaneously. The first part relates to the abundance of krill remaining after the introduction of the harvest strategy (catch limit in this case). The reference

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[32] Official documents of the Commission, *Report of the Tenth Meeting of the Commission*, (CCAMLR-X), Hobart, 1991, para. 6.13.

[33] S. Nicol and W. de la Mare, "Ecosystem management and the Antarctic krill", *American Scientist*, 1993, vol. 81, pp. 36-47.

[34] "An approach to a management strategy for the Antarctic marine ecosystem", in SC-CAMLR, *Selected Scientific Papers 1982-1984*, Part II, pp. 1-14, 1985; J.R. Beddington and W.K. de la Mare "Marine mammal fishery interactions: modelling and the Southern Ocean", in SC-CAMLR, op. cit., pp. 155-178; D.S. Butterworth, "Antarctic ecosystem management", SC-CAMLR, op. cit., pp. 15-42.

[35] W.K. de la Mare, "Some principles for fisheries regulation from an ecosystem perspective" in SC-CAMLR, *Selected Scientific Papers*, 3, pp. 323-340, 1987.

[36] Official documents of the Commission, *Report of the Seventh Meeting of the Commission*, (CCAMLR-VII), addendum, Report of the meeting of the Working Group for the Development of a Conservation Strategy for Antarctic Marine Living Resources, Hobart, 1988.

[37] A.J. Constable, "Managing fisheries effects on marine food webs in Antarctica: trade-offs among harvest strategies, monitoring, and assessment in achieving conservation objectives", *Bulletin of Marine Science*, 2004, vol. 74, pp. 583-605; A.J. Constable, "Setting management goals using information from predators", in *Top predators in marine ecosystems: their role in monitoring and management*, I.L. Boyd, S. Wanless and C.J. Camphuysen, eds., Cambridge University Press, Cambridge, 2006.

point prior to fishing was considered to be the median abundance of krill in the absence of fishing, which is the abundance about which the population would fluctuate such that the population would be above that level half the time and below it for the other half. In a single stock context, the usual "target level" after fishing is fully developed is for the median abundance to be 50 per cent that of the unexploited median abundance. CCAMLR agreed that this did not provide for predators of krill and the maintenance of the ecosystem. In the absence of further information, CCAMLR agreed that an appropriate target would be a median abundance of 75 per cent of the pre-exploitation median, half way between not taking account of predators (50 per cent) to taking full account of predators (100 per cent - no fishing).

The second part of the objective relates to a limit reference point below which the abundance of the population should not be reduced. This was set by CCAMLR at 20 per cent of the pre-exploitation median. The aim of this limit is to help ensure that the productivity of the stock is not reduced to a point that the stock cannot sustain itself or recover to pre-exploitation levels.

Since then, CCAMLR has specified objectives for toothfish and mackerel icefish consistent with these criteria. CCAMLR has recognized that the objectives for mackerel icefish may need to be refined in the future in order to take account of the naturally large variations in stock abundance.

Over the last decade, there have been a number of investigations into explicit objectives for predators of krill, largely determined by the amount of krill needed to be left to sustain the productivity of predators in the long term. The Scientific Committee has identified that productivity of predators needs to be considered over the life time of the predators as the dependence of predators on krill may vary from one year to the next as well as between locations in the Southern Ocean.

The Scientific Committee is currently in the process of specifying objectives for the krill fishery in small-scale management units in the southwest Atlantic. In originally establishing the precautionary catch limit for krill, CCAMLR agreed to the smaller scale subdivision of Area 48 to accommodate the specific needs of krill predators. This recognized that land-based predator colonies, or other populations of krill predators dependent on small-scale areas of krill, might be impacted if the entire catch for Area 48 was taken out of a single small area. In 2002, CCAMLR agreed to a system of small-scale management units that would provide an ecological foundation for such a subdivision, thereby accounting for the small-scale dependencies in the Antarctic marine ecosystem, even though the krill stock in the southwest Atlantic extends from the Antarctic Peninsula throughout Area 48. The ultimate aim is to subdivide the krill catch for Area 48 to ensure that the ecosystem objectives of CCAMLR can be met on scales consistent with all elements of the marine ecosystem and not just the scale of the target species.

D. DEALING WITH UNCERTAINTY: THE PRECAUTIONARY APPROACH OF CCAMLR

The advantage of defining agreed operational objectives is demonstrated in their application in assessing catch limits and other harvest controls. The precautionary approach was developed

initially by CCAMLR for the krill fishery and later extended to the toothfish and mackerel icefish fisheries.

This approach seeks to determine the long-term annual catch limit that is highly likely to be sustainable despite uncertainties in stock dynamics and key population parameters. It is envisaged that this approach is used in the interim of developing longer-term feedback management procedures. This approach uses simulation methods to project a stock forward using possible sets of population and fishery parameters. Given the uncertainties in these parameters then many simulated projections are undertaken with the variety of combinations of those parameters. The long-term annual catch limit is set at the catch level that satisfies the decision rule based on the objective. These rules are specified as the greatest catch that results in both a median expectation that the stock is greater than or equal to the target level at the end of 20 years or one generation period of the stock (whichever is greater) and there being only a 10 per cent chance or less that the stock will become depleted (below the limit reference point) over that time.

This approach shows the utility of simulation methods for undertaking assessments and for evaluating whether harvest strategies, in this case catch limits for krill, are likely to meet the objectives of the Convention.

E. INCORPORATING MONITORING AND FEEDBACKS INTO MANAGEMENT DECISIONS

CCAMLR has adopted a number of strategies for acquiring the data and information necessary for conserving the Antarctic marine ecosystem. In terms of targeted species, CCAMLR routinely receives fishery-independent survey and other research data from Members to assist with assessments of krill, toothfish and mackerel icefish. In addition, the Scientific Committee coordinated a multinational survey of krill stocks in the southwest Atlantic in 2000 to assist with setting catch limits for that region [38]. Other research programmes are undertaken through the fisheries activities themselves, as specified in conservation measures, including mark-recapture (tagging) programmes and the collection of fisheries related data. In the case of the latter, these are coordinated and undertaken by the CCAMLR Observer Programme, which has a 100 per cent coverage of finfish fishing vessels. This programme has been found to be essential in providing necessary data for assessments on target and by-catch species, including by-catch of seabirds and elasmobranches (primarily skates and rays). The observer programme remains to be applied to the krill fleet.

An important development early in CCAMLR was the establishment of the CCAMLR Ecosystem Monitoring Programme, which aims to monitor, using agreed methods, important land-based predators of krill in order to detect the effects of the krill fishery on the ecosystem [39]. Several parameters are monitored for each predator species. The temporal and geographic scales over which these parameters are expected to integrate changes in the status of the ecosystem varies from several weeks and local (reflecting the duration of foraging trips: (chick diets and

[38] P.N. Trathan and others, "The CCAMLR-2000 krill synoptic survey: a description of the rationale and design", *CCAMLR Science*, 2001, vol. 8, pp. 1-24.

[39] D. Agnew, "Review: the CCAMLR Ecosystem Monitoring Programme", *Antarctic Science*, 1997, vol. 9, pp. 235-242.

growth) to annual/semi-annual, and region-wide (the weight of birds arriving to breed, breeding success, population size). Aspects of sea-ice and hydrographic conditions are monitored because of their importance in governing the distribution, abundance, movements and recruitment of krill as well as the distribution, winter survival and timing and access to breeding colonies of its predators.

Field work and data acquisition are carried out voluntarily by member States. Data collected are submitted to the CCAMLR Secretariat, which generates summaries of trends in the monitored parameters, including the identification of anomalous years. Currently, there is no formal mechanism for including these data in a feedback management procedure for krill. The Ecosystem Monitoring Programme is currently under review with the aim of refining and including its outputs in such a management procedure. One of the challenges facing the Programme is to have sufficient spatial coverage to monitor the impacts of fishing at relevant spatial scales and for predators feeding in areas where fishing may be concentrated. [40]

The Scientific Committee has embarked on evaluating feedback management procedures for krill [41]. To do this, it is using ecosystem models in the evaluation framework. [42] This process will explore how the conservation of krill stocks and their predators will be conserved under different fishing scenarios, given different approaches to field monitoring. In the first instance, these models are being used to provide advice on subdividing the krill catch limit for the southwest Atlantic. [43]

F. DEVELOPING FISHERIES IN THE ABSENCE OF DATA

In establishing its precautionary approach, CCAMLR also agreed that the development of any fishery should not occur at a rate faster than CCAMLR is able to evaluate its potential consequences and whether the objectives in article II would be met. [44] To that end, CCAMLR adopted measures requiring Members to notify their intention to undertake a new fishery in the Convention Area [45] and their intention to undertake further exploration following the initiation of a fishery. [46] These measures provide the opportunity to authorize fishing activities in the Convention Area, ensuring that these activities remain sustainable. This important requirement

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[40] A.J. Constable, "The ecosystem approach to managing fisheries: achieving conservation objectives for predators of fished species", *CCAMLR Science*, 2001, vol. 8, pp. 37-64; A.J. Constable, "Managing fisheries effects on marine food webs in Antarctica: trade-offs among harvest strategies, monitoring, and assessment in achieving conservation objectives", *Bulletin of Marine Science*, 2004, vol. 74, pp. 583-605.

[41] Official documents of the Scientific Committee, *Report of the Twenty-third Meeting of the Scientific Committee*, (SC-CCAMLR-XXIII), Hobart, 2004, annex 4, Report of the Working Group on Ecosystem Monitoring and Management; for background examples of management procedures, see A.J. Constable "CCAMLR ecosystem monitoring and management: future work" *CCAMLR Science*, 2002, vol. 9, pp. 233-253.

[42] Ibid., annex 4, appendix D, Report of the Workshop on Plausible Ecosystem Models for Testing Approaches to Krill Management.

[43] Ibid., *Report of the Twenty-fourth Meeting of the Scientific Committee* (SC-CAMLR-XXIV), annex 4, appendix D, Report of the Workshop on Management Procedures, Hobart, 2005.

[44] Official documents of the Commission, *Report of the Eighth Meeting of the Commission*, (CCAMLR-VIII), Hobart, 1989; ibid., *Report of the Ninth Meeting of the Commission* (CCAMLR-IX), Hobart, 1990.

[45] Ibid., Report of the Tenth Meeting of the Commission (CCAMLR-X), Hobart, 1991.

[46] CCAMLR. Report of the Twelfth Meeting of the Commission. CCAMLR : Hobart, 1993. 133 pp.

for fisheries management has been identified by FAO [47] in relation to the precautionary approach.

These requirements enable the Scientific Committee to evaluate the types of limitations to fishing operations that may be required in the early stages to satisfy conservation objectives while enabling reasonable prospecting within the new fishery. In the exploratory phase, the Scientific Committee will specify the types of information to be submitted that will facilitate assessments of the fishery, including research activities that may be required. This is exemplified by the experimental designs applied in the crab fishery in Subarea 48.3 and for examining the potential impacts of trawling on the Antarctic continental shelf in Division 58.4.2 for which there remains a prohibition of bottom trawling in waters shallower than 550m pending further experimental work.

Measures so far imposed on new fisheries have included conservative catch limits for different management areas combined with local catch limits to avoid over-exploitation of localized stocks. For fisheries on Antarctic toothfish, areas have been defined for research purposes, small-scale research units, to facilitate the acquisition of information for stock assessments. Catch limits vary between these areas in an attempt to concentrate fishing activity in some areas while TACs are only small in order to improve the prospects of obtaining sufficient data for assessments and for ascertaining the possible effects of fishing. Other small-scale areas have lower catch limits, some being zero, as a precaution so as to reduce fishing activity while management approaches are developed for the region based on data from nearby areas.

G. BY-CATCH AND HABITATS

CCAMLR has adopted a number of measures to minimize by-catch of species in both long-line and trawl fisheries. The by-catch strategy aims to avoid by-catch wherever possible. If this cannot be achieved then mitigation measures and, if needed, by-catch limits are employed. The main by-catch groups receiving special attention are seabirds and elasmobranches. In the case of seabirds, a successful combination of avoidance and mitigation strategies has almost entirely eliminated seabird by-catch in licensed long-line fishing operations in the CCAMLR area by parties' vessels. The main tactics have included restricting the setting of lines to the least vulnerable times for seabirds (night time in winter), implementation of bird scaring devices (tori poles) and the adoption of a line weighting regime to accelerate sinking during the main vulnerable setting operation (baited hooks floating on or near the surface). For high latitude fisheries in summer, a stricter regime of line weighting and bird by-catch limits are in force. Research is continuing to improve these strategies in order to help improve the conditions for fishers. A remaining great concern to CCAMLR is that seabirds that breed in the CCAMLR Area continue to be killed needlessly and in large numbers in long-line fisheries to the north of the CCAMLR Area, because of inadequate by-catch mitigation measures in those fisheries. Such mortality has brought several albatross populations to the brink of extinction.

[47] FAO. Technical Consultation on the Precautionary Approach to Capture Fisheries and Species Introductions. FAO : Rome, 1995. 54 pp.

For elasmobranches, strategies are in place in long-line fisheries to release skates and rays before being hauled, thereby minimizing their mortality. Catch limits are also in place for each of the management units. In addition, vessels are required to "move on" from areas where by-catch catch rates are higher than acceptable levels. This aims to avoid localized depletion of by-catch species.

H. CATCH LIMITS AND MOVE-ON RULES ARE GENERALLY APPLIED ACROSS ALL BY-CATCH FINFISH SPECIES

Conservation

To date, CCAMLR has focused its attention on managing fisheries within the Convention area. However, it has broadened its focus in recent years to consider the conservation of biodiversity within the Convention area. In 2005, the Scientific Committee organized a workshop on MPAs and will hold a workshop on bioregionalization probably in 2007 to further consider these issues. [48] A longer-standing conservation issue has been an increasing recognition that successful conservation of seabirds requires coordinated management across a number of forums. As described above, CCAMLR has largely controlled the impacts of legitimate fishing operations on seabirds through eliminating fishing practices that are detrimental to seabird populations. However, Antarctic and Southern Ocean seabirds are still being killed at alarmingly high rates by IUU fishing operations within the CCAMLR Area, which do not implement the CCAMLR mitigation and avoidance measures, and in fishing operations outside of the CCAMLR Area. In order for these seabirds to be conserved, a coordinated effort across many jurisdictions will be required. CCAMLR has demonstrated a number of suitable methods for reducing and eliminating seabird by-catch. In the absence of other methods, it would be useful to have the CCAMLR methods adopted across the relevant jurisdictions.

I. COMPLIANCE AND ENFORCEMENT

From the late 1990s, CCAMLR has endeavoured to eliminate IUU fishing by elaborating and implementing a wide range of innovative compliance and enforcement measures, such as a catch documentation scheme for toothfish, a centralized vessel monitoring system, lists of vessels engaged in IUU fishing in the CCAMLR Area, and several port and flag State controls. Further work is needed to harness wider international support among non-parties for such measures and to develop an internationally capable enforcement capacity, including a robust boarding and inspection regime.

J. CCAMLR AS A MANAGEMENT SYSTEM

The developments described above have almost completed an internationally coordinated management system from data acquisition, assessments, harvest controls and compliance and enforcement (figure 24). CCAMLR is continuing this work using expertise in international

[48] Official documents of the Scientific Committee, *Report of the Twenty-fourth Meeting of the Scientific Committee* (SC-CCAMLR-XXIV), Hobart, 2005.

policy, law and diplomacy, science, technology, economics, compliance and enforcement (figure 25).

Figure 24
Components of a marine management system, such as CCAMLR (This example is for fisheries but could be modified to reflect other activities.)
Investment is used to establish fisheries which accrue benefits that may lead to more investment. A population is exploited by a fishery. Management objectives will include consideration of the costs to the target species, the ecosystem and fishery as well as the need to maintain amenity value (conservation and economy) for the future. Data from the fishery, the exploited population and the environment will be used in assessments to determine whether the objectives are being met and, according to decision rules in a management procedure that indicate what regulations will be made in response to the assessments, regulations governing the fishery will be set or relaxed. Regulations only directly impact on human activities (fisheries or research) and are intended to indirectly affect the maintenance of the target species and the ecosystem. The large grey box represents the Antarctic marine ecosystem.

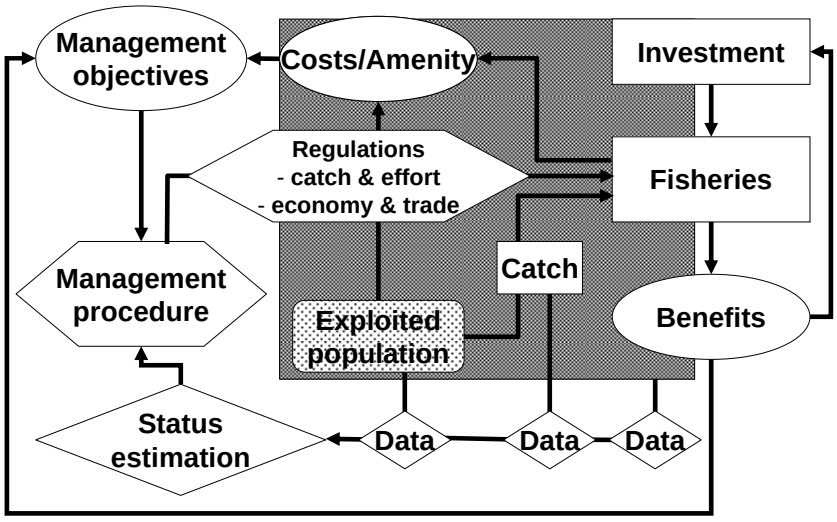
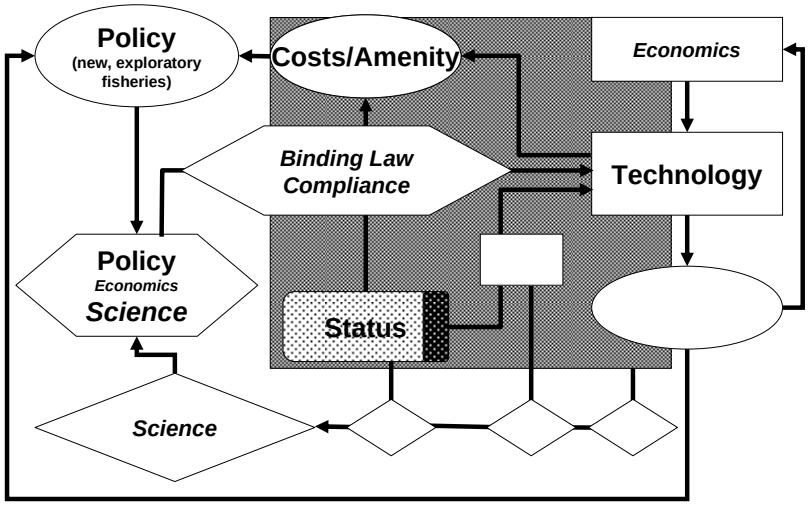


Figure 25

Work required in CCAMLR to establish regulated fisheries in a complete management system. Expertise required for the different elements in figure 24 are indicated in the respective symbols. Italicized text represents areas that need attention within the CCAMLR framework (smaller text requires more attention). This includes consideration of economic issues governing investment and the maintained value of fisheries into the future, the need for improved forms of regulation, compliance and enforcement, including methods for managing activities outside the Convention Area that impact on CCAMLR values (indicated by difference in shading of Status), and further scientific research to underpin EBM procedures and the precautionary approach.



The experience of CCAMLR has shown that, in order to be effective, CCAMLR needs, inter alia,

(a) To achieve participation in the Commission by all parties with a direct or genuine interest [49] in conservation and rational use of the Antarctic marine ecosystem;

(b) To ensure that parties with a direct or genuine interest in the Antarctic marine ecosystem embrace CCAMLR as the governing regional body and are given an opportunity to observe and have their views and potential interests taken account of in the current activities of the Commission;

[49] States that actively undertake a research programme in the Convention Area or participate directly in exploitation of Antarctic marine living resources (flag States).

(c) To facilitate cooperation and support of CCAMLR by non-parties that do not have a direct or genuine interest [50], including the opportunity to observe the current activities of the Commission;

(d) To maintain transparency and accountability that will ensure CCAMLR remains internationally recognized as the competent body governing activities in the Antarctic marine ecosystem;

(e) To have effective influence on limiting activities that might impact on CCAMLR's ecological and conservation values;

(f) To maintain orderly development of fisheries (new and exploratory as well as established) so that exploitation does not outpace the ability for CCAMLR to achieve its objectives;

(g) To develop a suite of management tools, based on the best scientific research, that has been evaluated for effectiveness prior to implementation;

(h) To identify appropriate regulations for harvesting marine species that will enable CCAMLR to meet its objectives;

(i) To ensure that actions and activities are implemented in a timely fashion, such that the ability to achieve the objectives of the Convention are not undermined by inertia in the management system;

(j) To maintain an appropriate and effective monitoring, control and surveillance regime, including monitoring, inspection and verification, of parties' vessels and controls to prevent IUU fishing by non-parties' vessels;

(k) As appropriate, to manage fishing and research activities so that the cost of both management (including assessment, compliance and enforcement) are integrated into decisions about exploitation;

(l) To maintain an appropriate and effective enforcement regime, including powers to terminate fishing operations;

(m) To have a recognized and effective suite of disincentives and sanctions for non-compliance;

(n) To provide a dispute resolution process.

[50] Such States would include port and trade States, who would not be regarded as having a direct or genuine interest in the conservation and rational use of Antarctic marine living resources but may wish to be observers in order to facilitate cooperation with and support of CCAMLR.

To a large extent, CCAMLR is achieving these requirements or, at least, has recognized the areas that need additional attention. A number of its recent initiatives in developing feedback management procedures for krill and in compliance and enforcement will help it achieve its ecosystem objectives. However, a limitation of CCAMLR remains the degree to which it is recognized and actively supported, including by non-parties, as the international body responsible for managing fisheries and conservation of Antarctic marine living resources in the Southern Ocean.

K. CONCLUDING REMARKS

CCAMLR is widely recognized as a progressive international Commission with the responsibility for the conservation of the Southern Ocean marine ecosystem. In its Convention and established practice, it

(a) Has the attributes of a RFMO while also having wider conservation responsibilities;

(b) Has been able to deliver a precautionary approach to fisheries management;

(c) Is a leading organization in the development of benchmarks for best-practice in the ecosystem approach to managing activities in waters outside national jurisdiction, including that:

(i) A science-policy framework for an ecosystem approach with binding conservation measures is tractable for high seas where little information is available;

(ii) Evaluation of management strategies in advance of issues arising reduces scientific and political conflict and identifies critical knowledge gaps;

(iii) An observer programme (including non-fishery related research on fishing vessels) is centrally important to providing data and advice to manage fisheries on the high seas (routine independent research is too expensive);

(iv) Monitoring, control and surveillance activities are essential with the aim of 100 per cent coverage;

(v) Mechanisms are needed to accommodate new entrants.

CCAMLR has notably achieved these advances in the international arena and without precedent, only guided by the principles of article II.

Despite the strong will of the parties of CCAMLR to achieve the objectives of the Convention, it will fall short of that goal if greater international cooperation and support are not achieved. In terms of regional cooperation, CCAMLR needs complementary binding regional arrangements in the areas to the north of CCAMLR in which Antarctic marine living resources might be found in order to achieve the conservation objectives for those taxa, such as seabirds and toothfish. More importantly, cooperation from all States with an interest in conservation and utilization of high seas resources needs to be achieved. At present, any State can choose not to

become a party to CCAMLR but still allow their flag vessels to fish in CCAMLR waters as unregulated fishers; such activities are also often illegal and unreported. This common practice seriously threatens the ability of CCAMLR to achieve its conservation and rational use objectives. Mechanisms are needed to ensure that States are obliged to only allow their vessels to fish in the region if that State is a party to CCAMLR and participates fully in the activities and obligations of the Commission, including contributing to the costs of managing fishing.

XIX. PACIFIC ISLANDS INTERGOVERNMENTAL COOPERATION TO IMPLEMENT ECOSYSTEM APPROACHES AT THE REGIONAL LEVEL [51]

Introduction

The main purpose of this presentation is to describe some of the activities of intergovernmental agencies in the Pacific Islands region to assist island countries to implement the ecosystem approach, particularly to fisheries management.

The Pacific small island developing States region is still at an early stage in the implementation of ecosystem approaches, so this is not a technical description of management activities and lessons learned, but it describes activities starting to get under way. One advantage that the Pacific Community can perhaps claim is that there are not many entrenched single-resource management systems to "unlearn", and there is a definite political will to make things happen on the broader front.

A. COUNCIL OF REGIONAL ORGANIZATIONS IN THE PACIFIC

To begin with, in talking about regional approaches in the Pacific, the intergovernmental agency system in the region should be explained. There is a network of intergovernmental organizations which works together as the Council of Regional Organizations in the Pacific, or CROP, with each agency taking the lead for a different set of sectoral responsibilities as follows:

(a) The Pacific Islands Forum Secretariat plays an overall role as regional coordinator serving the independent Pacific Island States at the political level and also has specialist responsibility for economic development planning and trade;

(b) The Secretariat of the Pacific Community is a diverse sectoral specialist agency, and serves not only the independent Pacific Islands Forum States but also the island territories of France, New Zealand, the United Kingdom and the United States. The Secretariat of the Pacific Community covers agriculture, health, forestry, national statistics and social issues, and its ocean-related work includes assistance to its members in the management and development of coastal fisheries and aquaculture, in fisheries science, and in implementing international standards in maritime shipping and ports.

As far as work on the Pacific Ocean is concerned, other CROP regional agencies are involved as follows:

(a) The Pacific Islands Forum Fisheries Agency specializes in assisting Forum countries in the management and development of tuna fisheries, and also assists islands in playing a full part

[51] "Pacific Islands regional approaches", presented by Tim Adams, Secretariat of the Pacific Community. This paper was developed from the script of the presentation.

in the implementation of the Western and Central Pacific Fisheries Convention through its new Commission;

(b) The Pacific Islands Applied Geoscience Commission specializes in non-living aspects of marine and freshwater ecosystems, including oceanographic and geospatially-oriented work, maritime boundary definition and charting;

(c) The Pacific Islands Regional Environment Programme is the regional environmental watchdog, and also plays a specialized role in relation to endangered marine species and ecosystems, and promoting protected areas;

(d) The University of the South Pacific is of course specialized in higher education and academic research, although it should also be noted that each of the CROP agencies has a strong vocational training role within their own areas of specialization.

All of these intergovernmental agencies liaise both bilaterally, and through the multilateral CROP Marine Sector Working Group, which is currently convened by the Secretariat of the Pacific Community and which will be the main driver for the development of regional support to Pacific small island developing States under the Pacific Islands Regional Ocean Policy.

Apart from the big environmental agencies, NGOs have not played a particularly prominent role in the Pacific Islands region to date, but they are now starting to proliferate, along with private sector representative organizations, and the region is currently working on a practical mechanism for engaging civil society representatives in regional intergovernmental organization activities.

B. THE PACIFIC PLAN

Apart from the institutional linkages within the CROP system, a major mechanism of linkage between Pacific intergovernmental organization work programmes will become the Pacific Plan. This was developed by Forum Heads of Government in 2005. It is not a comprehensive blueprint for sustainable development in all sectors, but instead concentrates on certain areas needing additional effort – areas that are critical for strengthening regional integration between countries, and promoting socially and environmentally sustainable economic growth.

Because the Pacific Plan is targeted in this way, there are certain sectors which are not included in the Plan itself – areas which are already considered to be as well-addressed as possible at the regional level, or which are best pursued at the national level: areas such as agriculture and forestry. And at the earlier stages, ocean issues and fisheries were not proposed for inclusion in the Plan. However, the ecosystem approach to fisheries management was included in the final version of the Plan when its long-term role in maintaining sustainability in the economic development of one of the region's most important natural resources was recognized.

The Pacific Plan thus now provides the overall reporting platform for CROP regional IGO work on the ecosystem approach, at least in fisheries, and the Secretariat of the Pacific Community and the Forum Fisheries Agency are currently in the process of working out indicators for measuring progress in this regional work-area.

C. REGIONAL IMPLEMENTATION OF THE ECOSYSTEM APPROACH TO MANAGEMENT

The Secretariat of the Pacific Community has been interested in the EAF management for some time, but mainly in an observational role because it was initially unclear just how the ecosystem approach should be implemented at the practical level. One of our main linkages has been with the Western Pacific Regional Fishery Management Council of the United States, and the development of the United States insular Pacific coral reef ecosystem fisheries management plan, involving the Pacific Community island members which are also territories of the United States, has been very instructive.

However, together with the Forum Fisheries Agency and others, we are now starting to move into the implementation of the EAF management in the rest of the insular Pacific. This year the region will be developing a regional framework for the application of the principles of the ecosystem approach to coastal fisheries management, building upon the tuna fisheries ecosystem approach framework already starting to be implemented through the Forum Fisheries Agency, which draws particularly on the Western Australian experience. The Pacific Islands Forum statement on the first day of the Consultative Process meeting mentioned the formal commitments that both the Forum Fisheries Agency and the Secretariat of the Pacific Community have made to the ecosystem approach, which now forms the majority of both our work-programmes in fisheries management.

Much of this commitment will be implemented at the national level, but the new Western and Central Pacific Fisheries Commission will play a part at the regional level, with input from the Forum Fisheries Agency and from the Oceanic Fisheries Programme of the Secretariat of the Pacific Community.

D. OTHER ACTIVITIES

Regional intergovernmental applications of the ecosystem approach in the Pacific Islands region have concentrated on the management of fisheries because fisheries is currently the major ocean use issue in the region. This is where the more formal implementation of the ecosystem approach is occurring. However, CROP agencies are also providing assistance to Pacific Islands to implement ecosystem approaches in broader areas, and these are all conceptually, if not programmatically, connected under the regional ocean policy framework.

The continuing work of the Pacific Islands Regional Environment Programme on integrated coastal management and the institutionalization of MPAs is notable, and indeed all of the Programme's work is compatible with an ecosystem approach. The Pacific Islands Applied Geoscience Commission is providing vital input, particularly in marine mapping, marine scientific research coordination, marine boundary delimitation, freshwater issues and seabed

minerals, while the University of the South Pacific is helping build future human resource capacity in these areas.

There are also several other what might be called “ad hoc” ongoing regional activities, particularly in fisheries, that contribute towards an ecosystem approach.

In tuna fisheries, the Western and Central Pacific Fisheries Commission is one of the first RFMOs to be developed on the basis of the United Nations Fish Stocks Agreement, and the first substantive meeting of the Western and Central Pacific Fisheries Commission made resolutions last December to cap the regional catch of tuna and to implement measures concerning turtles, seabirds and IUU fishing. This is notable because this is the first time that it has been possible to develop measures affecting pelagic fisheries on the high seas in the Pacific Islands region.

In deep-sea trawl fisheries – something which has not been a pressing issue for the Pacific Islands where deep-sea trawl fisheries are not economically active in the tropical area – the region has become committed to the development of an effective precautionary management regime for these extremely fragile benthic resources and seamount ecosystems. The region is currently at the point of deciding whether to include the Western Tropical Pacific Insular Area within the developing South Pacific temperate arrangement, where fishing is already occurring, or to have a separate, pre-emptive arrangement for the tropical area where there is no declared commercial deep-sea trawling. The Forum Fisheries Committee has recommended wording for a regional statement on this issue to be made by Pacific Islands Forum Heads of Government at their meeting in October 2006. It is also expected that this meeting will agree to some definite measures concerning implementation, including interim measures.

It should be noted that cost-effectiveness will be a major factor in deciding what quantity of developing country resources can be diverted into implementing these arrangements, and the absence of commercial trawl fisheries in the region means that there is not much expectation that a fishing industry will subsidize the costs of enforcement.

There are also major efforts within the region to limit fisheries by-catch, particularly of endangered species, and the region is expending considerable effort – with good results – not only to limit the catch of turtles by long-liners but to protect nesting beaches. It has already been determined that seabird by-catch is not a conservation issue in the Pacific Islands Forum work area. Tuna long-lining is currently of critical economic importance to the region, particularly the smaller islands of Polynesia and Micronesia, and is one of the few viable economic development options available, apart from selling access to foreign fishing vessels and, for a few islands, tourism. Pacific Island fishermen are anxious to ensure that the countries that import their fish do not perceive their activities as being environmentally unsustainable, and are making great efforts to minimize their impacts.

E. ECOSYSTEM INDICATORS

At the technical level, the Secretariat of the Pacific Community is spending a considerable proportion of its resources trying to understand oceanic and reef ecosystems. In this regard we recognize that the fundamental basis of EAM is to control human impacts on the ecosystem in

relation to the status of whole ecosystems, not just in relation to the status of the exploited resource. With oceanic fisheries it is likely that the tuna species themselves are the best indicators of the state of the pelagic ecosystem, but in coastal fisheries ecosystems there is a great deal of work to do before we can develop reliable and meaningful ways of assessing ecosystem status.

Although the region is making progress here, it is not yet possible for most Pacific Islands to reliably monitor the status of coastal fishing, let alone the status of ecosystems. Very few small Pacific Island countries have the capacity to collect data from their largely artisanal fisheries, and there is even less capacity for monitoring non-fisheries aspects. There will be heavy reliance upon occasional comprehensive surveys assisted by intergovernmental and nongovernmental agencies, coupled with the continuous monitoring of certain indicators.

F. SOCIAL BACKGROUND

Applying the ecosystem approach will be a major challenge to the tropical Pacific, given the material and human constraints of developing countries, particularly small-island countries. However, we do not think it is an insuperable challenge. For tuna fisheries – our most economically important ocean sector – the islands are already making headway, and for coastal fisheries we are committed to making it happen. And the formal application of the ecosystem approach in other ocean sectors is being considered.

The Pacific Islands region is assisted by two factors:

(a) There is a relatively cohesive regional system through which countries can help each other and pool access to external resources - a system within which the ecosystem approach is already accepted as the way forward, and the "best practice" for natural resource management;

(b) Another is that across the region there are traditional and ancestral systems of resource ownership and area tenure that already recognize the land and sea as a continuum. This will be particularly important in recognizing and controlling land-based impacts on coastal ecosystems. At the traditional level at least, the societal basis for the ecosystem approach is already there – and in some Pacific Islands these systems are already formally recognized by the State.

G. REGIONAL COMMITMENT

The Pacific Islands Forum statement at the start of the 2006 Consultative Process meeting made it clear that the Pacific Islands fully intend to fulfil the commitment that they made at the World Summit on Sustainable Development – that of implementing the ecosystem approach by 2010.

Of course this depends on how the ecosystem approach is actually defined, and the Consultative Process will have a major influence on that definition, or indeed whether a globally accepted definition should even be attempted at this stage. If the ecosystem approach is defined to require a full scientific understanding of the interrelationship of every ecosystem component, to the level where whole-ecosystem models can be built, and can reliably guide management

decisions, then the approach is unlikely to be implemented by the deadline, at least with all but the simplest ecosystems. But if the aim is to develop or empower the institutional systems necessary to make decisions on the basis of indicators of whole ecosystem state, rather than just managing on the basis of indicators of target species state, then this is achievable.

H. OCEAN POLICY

To conclude, it also needs to be pointed out that, as well as making decisions to guide ecosystem management, Pacific Island societies also need to make fundamental decisions about what state they need ecosystems to be in – to define the end-point of the management process – and for this socially negotiated understanding to be regularly reviewed.

Nature itself does not often maintain steady-state ecosystems, and when it comes to maintaining human populations some compromises between different stakeholders will be necessary. But they need to be informed compromises, with a clear idea of the path that is being taken, the cons as well as the pros, and the implications of these decisions. The overall vision of the Pacific Islands Regional Ocean Policy is to maintain a healthy ocean, but an ocean that can support and maintain Pacific Island human populations in perpetuity. Informed balances must be struck between fishing, tourism, heritage uses, ocean farming, transport, mineral extraction, energy, and all other potential uses, and different balances have to be defined at different scales, from the whole-ocean basin, or the exclusive economic zone, to the individual island community fishing ground.

Developing the scientific basis, and the social mechanism, for enabling these informed choices is the next major challenge, and is something that we envisage occurring under the framework of the regional ocean policy, and forthcoming Pacific Island national ocean policies. A regional ocean policy facilitation office is planned, to act as a nucleus for these processes.

XX. REGIONAL COOPERATION IN ECOSYSTEM-BASED MANAGEMENT IN THE SEAS OF EAST ASIA: THE PARTNERSHIP APPROACH [52]

A. WHAT IS PARTNERSHIPS IN ENVIRONMENTAL MANAGEMENT FOR THE SEAS OF EAST ASIA?

Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) is a regional project of the Global Environment Facility, implemented by the United Nations Development Programme (UNDP) and executed by the International Maritime Organization (IMO). The project focuses on environmental management for the Seas of East Asia which is composed of six LMEs, namely, the Yellow Sea, East China Sea, South China Sea, Sulu-Celebes Sea, Indonesian Seas and Gulf of Thailand. It has major river systems draining into the regional seas with a combined watershed of 6.25 million km^2 (figure 26A).

PEMSEA evolved as a regional project (1994–1999) on marine pollution prevention and management under the GEF pilot phase with the participation of 11 countries in the region and a budget of US$8 million. Its second phase (1999–2006), now with 12 member countries, focused on building intergovernmental, interagency and multisectoral partnerships in environmental management for the seas of East Asia. It has a total GEF contribution of $16.2 million. Towards the end of the second phase, the countries of Myanmar, Lao People's Democratic Republic and Timor-Leste joined PEMSEA, making a total membership of 15, viz. China, Democratic People's Republic of Korea, Japan and Republic of Korea in the north and the ASEAN and Timor-Leste in the south, covering a total sea area of 7 million km^2 and a total coastline of 234,000 km.

Building upon its current structure, PEMSEA is in the process of transforming into a longer-term regional arrangement to implement a regional marine strategy, the Sustainable Development Strategy for the Seas of East Asia, with GEF financial support and significant co-financing from the participating countries beginning 2007.

B. THE CHALLENGES

The East Asian Seas Region, in common many regional seas in other parts of the world, faces the following challenges:

First, governance issues confronting the sustainable use of goods and services and environmental sustainability in the seas of East Asia are very complex owing to the very high population pressure (with 1 billion people living near the coasts), the wide range of economic activities in the coastal and marine areas, the changing use and consumption patterns, the uneven economic development among countries (the region is host to developed, developing and least developed countries), and socio-economic, political, cultural, religious complexities, albeit with

[52] Presented by Chua Thia-Eng, Partnerships in Environmental Management for the Seas of East Asia.

a strong traditional connectivity. Most Governments still maintain a "development first" policy or attitude. Management measures remain weak.

Secondly, capacity and economic disparity among countries in East Asia pose a major challenge to regional cooperation in achieving sustainable coastal and ocean development owing to the wide financial and technical capacity gaps between the developed, developing and least developed nations. The vast capacity gaps have made it difficult for countries in the region to effectively address severe environmental threats which include destruction of habitats, loss of marine biodiversity, deteriorating water quality, alteration of coastlines, depleted marine resources, IUU fishing, and many more. Many of these threats are transboundary in nature, requiring cooperation among the affected countries.

Thirdly, the lack of national and regional coordinating mechanisms or the institutional "home base" for coastal and ocean development and management exacerbates the imbalance between economic development and ecosystem conservation. The failure or deficiency in interagency and multisectoral coordination at national and local levels, which often leads to interagency and multiple-use conflicts, has compromised the natural marine heritage, undermined natural defence, damaged the functional integrity of ecosystems and largely jeopardized the development of both the ecological and biological economies of the future.

Fourthly, scientific support in coastal and ocean governance has yet to be mainstreamed in the policy and management paradigm at all levels so that policy and management decisions are based on appropriate scientific advice. Given the technical capacity disparity in the region, scientific support has not played a major role in the decision-making process.

C. THE PARTNERSHIP APPROACH IN ECOSYSTEM-BASED MANAGEMENT

PEMSEA has adopted the concept of EBM for river basins, estuaries and coastal seas in the region through the application of integrated and adaptive management approaches in addressing pollution, loss of habitats and biodiversity, depletion of fisheries and marine resources, coastal reclamation, and other coastal and marine issues in the context of the socioeconomic, political, cultural and ecological characteristics of the region (PEMSEA, 2004). PEMSEA applies the hierarchical principles to integrated coastal management (ICM) practices by effectively utilizing the fundamental approaches, operational strategies and the availability of tools and international environmental instruments to achieve the overall goal of sustainable development at the local level and sub-regional and regional seas (table 7). Integrated coastal management mobilizes the three key sectors of society -- government, private sector and NGOs -- in partnership, and uses the key dynamics of integrated management towards achieving environmental sustainability.

Table 7
Application of the hierarchical principles to the integrated coastal management practices

Overarching goal Operational definition of sustainable development	Integrated coastal management
Fundamental approaches	Integration and interrelationship principles Adaptive management Ecosystem-based approach Environmental protection Sustainable livelihood Vulnerability/resilience thinking
Operational strategies	Effective governance Institutional arrangements Multi-stakeholders participation Functional partnerships/networking Knowledge management Capacity development Financing arrangements Monitoring and evaluation Scaling up
Tools and instruments	Coastal strategy and implementation Governance analysis Coordinating mechanisms Risk assessment Environmental impact assessment Stakeholder analysis Cost-benefit analysis Participatory tools (negotiation, conflict resolution, arbitration) Legal/regulatory instruments (land- and sea-use planning, marine resource allocation, codes, standards, etc.) Economic instruments (charges, subsidies, quotas, fines, incentives, etc.)

D. PARTNERSHIPS AT THE LOCAL LEVEL

PEMSEA has set up a series of ICM demonstration sites to serve as working models for ICM application. Achievements in local actions such as conflict resolution, improvement of coastal landscapes, effective waste management, clean beaches and habitat restoration in several ICM demonstration sites in the region create confidence and capacity in coastal management and thereby generate more interest among local governments in replicating ICM practices. Twenty-six local governments in nine countries have set up and sustained ICM programmes using their

own financial resources (figure 27). Efforts are now being made to scale up ICM practices. The PEMSEA Network of Local Governments has been established, with one of the local governments (Xiamen, China) hosting the regional secretariat and an annual event, the International Forum on Sustainable Coastal Cities, during the World Ocean Week.

PEMSEA has demonstrated that the ICM framework, process, platforms and tools can be effectively applied to address issues related to marine pollution, conservation, fisheries, sea-level rise, mariculture, ecotourism, use conflicts and many other issues pertaining to the sustainable use of coastal and marine resources.

E. PARTNERSHIPS AT THE SUBREGIONAL LEVEL

Based on experience in local ICM implementation, management efforts have extended beyond administrative boundaries within or between national jurisdictions. A subregional agreement between Cambodia, Thailand and Viet-nam for oil and chemical spill preparedness, response and cooperation in the Gulf of Thailand is now in operation, with appropriate private sector groups involved in oil spill training and response. In Manila Bay, Philippines (figure 26 B, C, D), political commitments at national and provincial levels have been forged through the Manila Bay Declaration and subsequently through the Operational Plan adopted by the Manila Bay Project Coordinating Council. There is a current effort to develop a new institutional/coordinating mechanism for the integrated management of Laguna Lake, Pasig River and the Manila Bay. In effect, ICM is streamlined into the national coastal and ocean management programme. Risk assessment information is being considered for policy decisions with respect to the possible designation of Manila Bay and adjacent water bodies as a "non-attainment area" under the Clean Water Act. In the Bohai Sea, the inner sea of China, cooperation between three provinces and two cities has been promoted through the Bohai Sea Declaration and the implementation of the Bohai Sea Management Strategies. Appropriate legislation on Bohai Sea Management has been tabled at the national assembly while over $5 billion of environmental infrastructure will be built along the coastal cities bordering the Bohai Sea in order to reduce nutrient loading in rivers and bays.

F. PARTNERSHIPS AT THE REGIONAL LEVEL

With the development and endorsement of the Sustainable Development Strategy for the Seas of East Asia (PEMSEA, 2003), the countries of the region have now moved forward to implement a common regional marine strategy that responds to the World Summit on Sustainable Development, the United Nations Conference on Environment and Development, the Millennium Development Goals and several ocean-related regional instruments including the Seoul (2002) and Bali (2005) Declarations of the APEC Ocean-related Ministers and several strategies and action plans.

The 15 PEMSEA participating countries have agreed on a set of priority actions for the next 10 years, including the formulation of rolling 10-year national plans of action to implement the 217 action programmes of the Strategy. A number of these plans already exist or are projected government activities. Initial estimates of national expenditure/budget already committed have

reached a combined $4 billion. It is expected that national investments in implementing action programmes listed in the Strategy will exceed the committed amount many times over.

Regional implementation of the Strategy in the initial 10 years (2007–2016) shall focus on these major component activities:

(a) To mobilize the necessary regional partnerships, capacities and services, as well as legal, financial and institutional arrangements for the sustainable implementation of the Strategy. The partnership mechanism will be participated in by governments, the business sector, NGOs, the academe, and other stakeholder partners;

(b) To promote, facilitate and assist interested countries in the development/formulation of national coastal and ocean policy so that by 2016, 70 per cent of the participating countries will have a national coastal or ocean policy, through policy seminars to increase policy awareness and political commitments, and policy support in terms of marine sector contribution, particularly ocean contribution to future ecology and biological economic paradigm;

(c) To scale up ICM programmes to cover 20 per cent of the region's coastlines by 2017 so as to develop a critical mass of local governments practicing ICM and increase appreciation of the benefits of ICM practices with a view to self-multiplication of ICM practices throughout the region; through the development and operationalization of ICM training centres and regional and national ICM task forces to promote and assist local governments in the implementation of ICM practices;

(d) To implement EBM of watersheds, estuaries and adjacent coastal seas through the sharing of knowledge and experience, particularly through twinning arrangements of successful management regimes of large water bodies in developed countries such as the Chesapeake Bay in the United States and Seto Inland Sea in Japan with management initiatives in the region including Masan-Chinhae Bay of the Republic of Korea, Bohai Sea of China, Manila Bay of the Philippines and Jakarta Bay of Indonesia;

(e) To initiate activities to reduce or narrow the technical capacity disparity within the region through capacity-building programmes using expertise from selected Areas of Excellence in the region; develop a network of universities and research institutions to provide ICM and specialized training; and strengthen regional expert networks and an information database to create dynamic teams of experts, trainers, and specialized institutions that could be mobilized to continue the noble function of capacity disparity reduction in the long term;

(f) To promote public and private sector cooperation for sustainable coastal development and create a policy environment for investment and financing of environmental infrastructure projects and services; and facilitate the implementation of public-private sector partnership for environmental infrastructure development;

(g) To form strategic partnerships between PEMSEA and other donor partners to generate investments for environmental improvement facilities to reduce the impacts of pollution, particularly in small and medium-sized cities and townships. Initially PEMSEA will form a

strategic partnership with UNDP and the World Bank for nutrient-reduction initiatives for LMEs in the region.

G. A NEW PARADIGM FOR REGIONAL COOPERATION - A PROCESS-AND PARTNERSHIP-ORIENTED REGIONAL MECHANISM

Although PEMSEA has been operating smoothly and successfully over the last 12 years, it is still project-oriented even with its programme focus. Institutionally, it is functioning under a United Nations (IMO) umbrella and lacks a legal personality of its own. It has become apparent that structural change to transform PEMSEA into a more permanent regional mechanism is a necessity for the following reasons:

(a) Implementation of the Sustainable Development Strategy for the Seas of East Asia to achieve the shared vision requires a dynamic and stable institutional arrangement to coordinate, facilitate and support national implementation;

(b) A good partnership foundation has been laid for regional cooperation involving all stakeholders of the region;

(c) Stronger national commitments have been secured with financial support not only from donors but also from the contributions of the participating countries;

(d) The Putrajaya Declaration, reflecting the countries' desire to cooperate, has provided the needed political commitments from the participating countries to implement the Strategy;

(e) GEF has provided the needed financial support for the follow-on phase thus creating an opportunity and the resources to facilitate structural change.

The Putrajaya Declaration, like any other declaration or resolution, is in fact a non-binding agreement, but anchors on the moral obligation of countries to commit their human and financial resources to ensure sustainable use of the shared natural ocean resources. The Putrajaya Declaration draws its inspiration from the concept, principles and objectives of the United Nations Conference on Environment and Development, the World Summit on Sustainable Development, the Millennium Development Goals and UNCLOS. The regional declaration and the regional marine strategy are a response to the international maritime and environmental instruments. Despite the lack of a regional convention, most countries have demonstrated willingness to contribute and commit to the implementation of the Strategy.

Under the Haikou Partnership Agreement, which is expected to be adopted in December 2006 by the concerned Ministers of the 15 participating countries, a new implementing mechanism will be developed. This new paradigm for regional cooperation differs from those of regional conventions in that the mode of regional cooperation is based on the spirit of partnership and the moral obligation of partners, be they Governments or otherwise, to comply with agreed principles, objectives and activities guided by a shared vision. Partnering stakeholders are required to sign the Partnership Operating Arrangements which delineates roles and responsibilities and is an annex to the Partnership Agreement. Unlike the conventional approach

which generally consists of a secretariat and an intergovernmental council, the new regional mechanism is made up of five interrelated components:

(a) A two-tier Partnership Council composed of both government representatives and those from the partnering stakeholders, to provide operational guidance, monitor progress and review new initiatives; the Partnership Council meeting is made up of two sessions: the intergovernmental session where only government representatives attend and the technical session where all partners participate. Decisions are based on consensus rather than voting;

(b) A gradually country-owned PEMSEA Resource Facility which provides both secretariat services for the regional cooperation and technical services for the implementation of Strategy-related projects. Governments provide financial support to sustain the operation of the Secretariat Services while the Technical Services shall be self-sustained through resources derived from project implementation;

(c) A Ministerial Forum which takes place triennially to renew political commitment and provide new policy direction for Strategy implementation;

(d) A Regional Partnership Fund to receive donations from governments or other donors for the implementation of the Strategy;

(e) An East Asian Seas Congress which takes place tri-annually for all stakeholders (Government, NGOs, academe, experts, business communities and other members of civil society) from within and outside the region to convene or co-convene seminars, workshops, exhibits and other side meetings to review progress in the implementation of the Strategy, and share information, experiences and knowledge.

The mechanism encourages the establishment or formulation of site or issue-specific subregional agreements within the overall framework of the Strategy. The subregional agreement between Cambodia, Thailand and Viet-nam on oil and chemical spill preparedness, response and cooperation in the Gulf of Thailand is a perfect example. Implementation will be strengthened through the cooperative framework of the Strategy. This approach will enable the region to streamline regional or subregional agreements and ensure a more effective, cohesive and vision-focused regional cooperation. Similarly, the PEMSEA Network of Local Government is based on a subnational agreement in the form of a Charter signed by participating local governments for the implementation of ICM in the region. Such arrangements provide a stronger bond between partnering stakeholders as these are based on common concerns which are more immediate in nature.

The new regional mechanism is process- and result-oriented in establishing and consolidating its operational functions (figure 28). It builds upon the 12 years of regional cooperation manifested through the GEF initiatives and operated within the United Nations framework. The process-oriented approach allows the regional mechanism to mature through succeeding phases, ensuring effectiveness, trust and commitment.

Effective implementation of the Strategy will certainly create stronger cooperation and collaboration among various coastal and ocean management initiatives, including regional and international organizations, in fulfilling their ocean-related mandates as well as strengthening individual management efforts in the six LMEs of the region.

Sustainability of the regional mechanism very much depends on its effectiveness. Participating countries and stakeholders need to gain confidence and trust before agreeing to a more permanent and binding arrangement.

H. PEMSEA IN TRANSFORMATION

The Regional Programme Office is now undergoing transformation to institutionalize its current project-based operation into a longer-term PEMSEA Resource Facility which provides secretariat and technical services to the participating countries. China, Japan and the Republic of Korea will provide annual cash contributions while the Philippines will continue to host the regional office, providing additional office space and facilities. By the end of 2006, the Second Ministerial Forum would have endorsed the Partnership Agreement and a group of partnering organizations signed the Partnership Operating Arrangement as founding members. The first Partnership Council will be held to officially establish the new regional ocean regime.

The timeline for the transformation of PEMSEA reflects a lengthy operational process: from project to programme focus, from intergovernmental cooperation to multi-stakeholder partnership, from a project office to a regional institutional structure and from being donor-driven to government and stakeholder-ownership. After 12 full years of operation (1994–2006), PEMSEA is entering into a critical phase of transformation during which the government and the partnering stakeholders will take the driver's seat and propel the region towards achieving the vision of the Sustainable Development Strategy for the Seas of East Asia.

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Figure 26

A. The Seas of East Asia; B. Philippine Archipelago; C. Manila Bay; D. Manila Bay Watershed

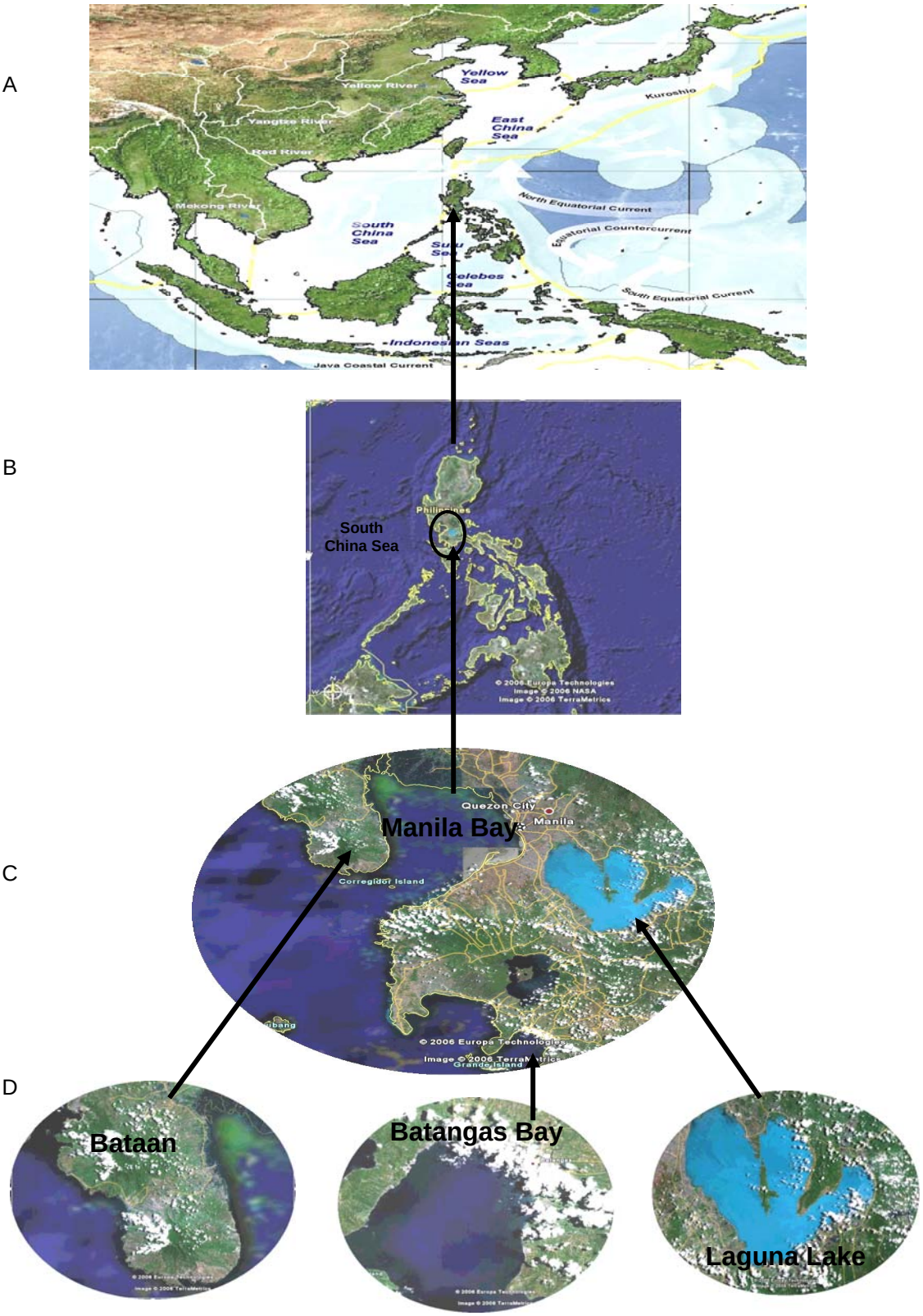
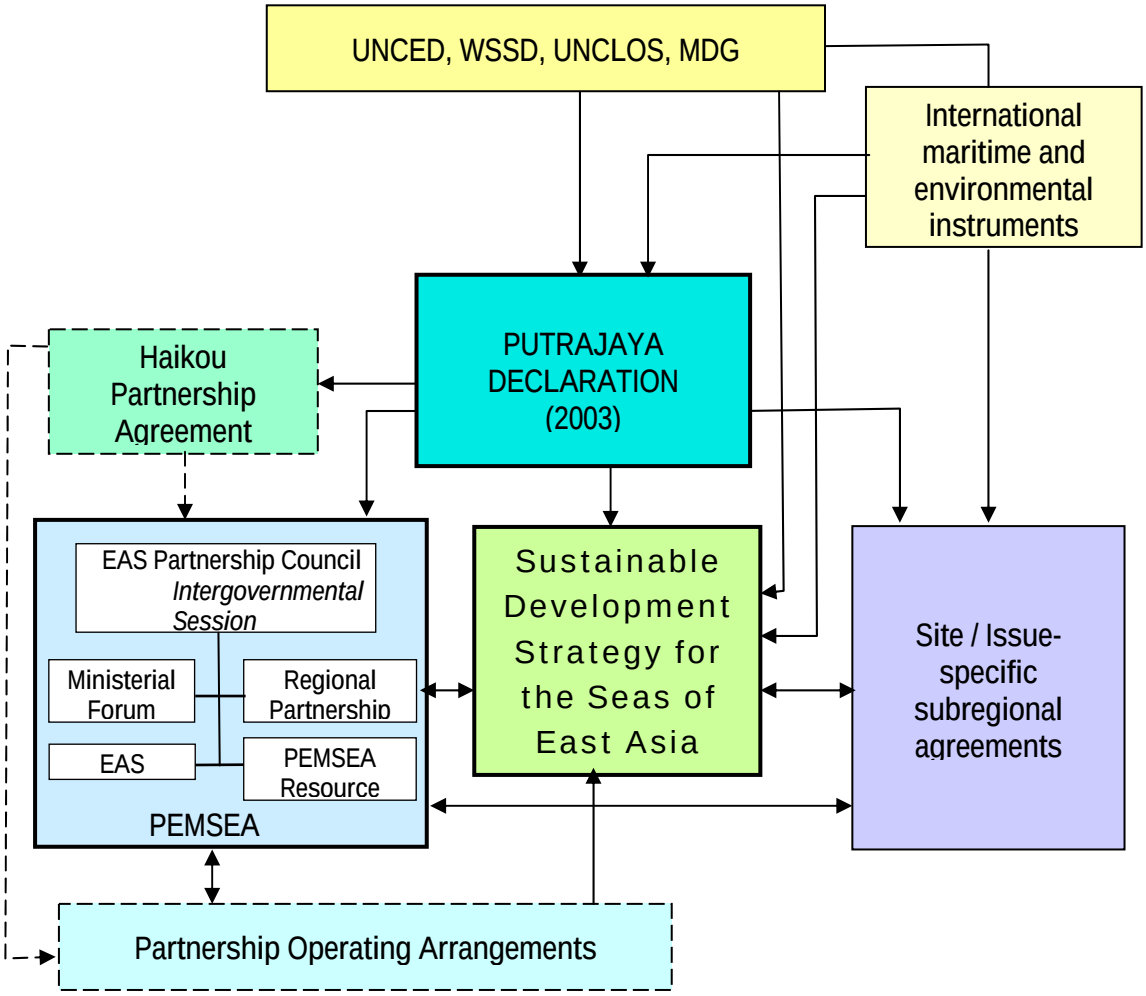


Figure 27

PEMSEA integrated coastal management demonstration and parallel sites and subregional hotspots in the seas of East Asia

Figure 28
A new paradigm for regional cooperation



Process- and Partnership-Oriented Regional Mechanism for the Seas of East Asia

- **Regional coordination**
- **Policy and functional integration**
- **Results focus: Effectiveness**
- **Partnership Agreements**
- **Subregional Agreements**
- **Subnational Agreements**

Abbreviations: UNCED=United Nations Conference on Environment and Development; WSSD=World Summit on Sustainable Development; UNCLOS=United Nations Convention on the Law of the Sea; MDG=Millennum Development Goals

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