Fisheries and Oceans Pêches et Océans

**Canadian Stock Assessment Proceedings Series 99/38**

**Évaluation des stocks canadiens Séries des comptes rendus 99/38**

# Proceedings of the Ecosystem Approaches to Fisheries Management Workshop

**31 August – 2 September 1999**

**Nova Scotia Agriculture College**
**Conference Centre**
**Agritech Park**
**Truro, Nova Scotia**

**Sponsored by**

**Fisheries and Oceans Canada**
**Maritimes Region**

**Odette Murphy[1] and Robert O'Boyle[2] (Editors)**

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## Abstract

The Department of Fisheries and Oceans (DFO) has an obligation to include ecosystem considerations, including impacts on forage species, in fisheries management plans. Therefore, DFO's Maritimes Region, conducted a workshop during 31 August – 2 September 1999 to develop ways of incorporating ecosystem considerations into fisheries management and to foster communication of the relevant concepts amongst stakeholders. Participation represented a broad cross-section of government and stakeholder groups in the Maritime Region. The workshop heard talks on regional ecosystem issues and how ecosystem considerations are being incorporated into fisheries management elsewhere in Atlantic Canada and the world. The workshop developed a list of issues considered important to the region's various stakeholder groups and discussed ways on how these might be addressed. The workshop format encouraged dialogue among participants and underlined the consistency on the issues and their potential resolution. A set of recommendations was produced that requires further action by DFO and stakeholder groups to ensure that the region can collectively move ahead on the incorporation of ecosystem considerations into fisheries management.

## Résumé

Le ministère des Pêches et des Océans (MPO) a l'obligation de tenir compte de l'écosystème, notamment des répercussions de la pêche sur les espèces fourrage, dans les plans de gestion des pêches. C'est pourquoi la Région des Maritimes a organisé un atelier, du 31 août au 2 septembre 1999, pour élaborer des moyens d'intégrer les considérations relatives à l'écosystème dans la gestion des pêches et pour faciliter la communication des notions pertinentes parmi les intéressés. Les participants à cet atelier constituaient un vaste échantillon de représentants des instances gouvernementales et des intervenants du milieu dans la Région des Maritimes. Ils ont entendu des discussions sur les questions régionales relatives à l'écosystème et sur la façon dont ce dernier est intégré à la gestion des pêches ailleurs au Canada atlantique et dans le reste du monde. On a établi une liste des questions jugées importantes par les divers groupes d'intervenants et discuté des moyens possibles de les régler. La formule de l'atelier a encouragé le dialogue entre les participants et fait ressortir la convergence au sujet des questions à régler et de leurs solutions possibles. L'atelier a débouché sur des recommandations nécessitant d'autres actions de la part du MPO et des groupes d'intervenants pour que la région progresse collectivement dans l'intégration des considérations concernant l'écosystème à la gestion des pêches.

## 1.0. EXECUTIVE SUMMARY

Under Canada's new *Oceans Act*, the Department of Fisheries and Oceans (DFO) has an obligation to include ecosystem considerations into management plans. Also, in June 1998, the Minister of Fisheries and Oceans announced a moratorium on all new forage fisheries in Atlantic Canada until a policy on the management of these species has been approved. DFO's Maritimes Region, conducted a workshop during 31 August – 2 September 1999 to initiate dialogue among government and stakeholders on these important issues. The workshop focused on ecosystem considerations in respect of fisheries at all trophic levels, not just forage species, in recognition of the fact that a comprehensive approach to the inclusion of ecosystem considerations into ocean resource management is required.

The objectives of the two-day workshop were to develop concrete ways and means of incorporating ecosystem considerations into fisheries management as well as to foster communication and education of these concepts among all stakeholders. Stakeholder involvement and input was considered paramount to the success of the workshop. A multi-sectoral workshop planning committee struck in fall 1998 ensured that the interests and concerns of key stakeholder sectors were incorporated into the workshop design and organisation. Invitations were issued to over 100 representatives from a representative cross-section of stakeholder groups in the Maritime Region.

The workshop heard ecosystem issues considered relevant to the various stakeholder groups from individuals invited to represent their sector's interests. The over 20 issues dealt with all aspects of the management system and could be categorised into those relating to management processes (objectives, strategies, regulations, monitoring and research), and governance (decision-making and information gathering). These formed the basis for discussions in working groups, which not only developed these issues further but also recommended ways as to how they may be addressed, in what turned out to be a remarkable level of consistency and consensus.

The workshop then considered initiatives being taken elsewhere to make an ecosystem approach workable, with particular emphasis on governance and implementation. These presentations drew heavily upon not only Maritimes experience, but also that internationally, as reported at the March 1999 Montpellier International Symposium on the Ecosystem Effects of Fishing. Based on the discussion, participants, through the working groups, were then asked to consider the following questions:

- How should consultations be conducted to allow a nested (community to regional and national as appropriate) approach to fisheries management decision making regarding the ecosystem approach?
- What potential pilot projects could be undertaken?
- What communication activities do we need to take now on the ecosystem approach?

- What are the things that could make an ecosystem approach fail and what actions do we need to take to avoid these?
- Any other recommendations?

A list of issues and recommendations resulted that will require further action by DFO and stakeholder groups. Overall, it was felt that an evolutionary rather than revolutionary change to the current management institutions was needed. There was also an identified requirement for overarching ecosystem boards to oversee the activities of the single species committees operating in specific ocean management areas. But the hierarchy had to go down as well as up, with local decisions being made by those most effected in the communities.

It was noted that there are a number of 'ecosystem' pilot projects currently underway (ESSIM, Bras d'Or Lakes, Bay of Fundy) that should be encouraged and built upon. However, it was considered that the ocean management area concept should be developed further, and be supported by the Regional Advisory Process (RAP), as it will form the operational basis of the incorporation of ecosystem considerations into fisheries management. It will also facilitate dialogue among stakeholders on competing ocean uses. A key element of these initiatives was considered to be effective communication, to which end a communications plan was recommended, again building upon current activities.

The workshop noted a number of factors that should be addressed to avoid failure of the initiative. It particularly underlined the need for a conflict resolution mechanism, the need for funding, consistency of management activities and definitions, effective communication, and a need for flexibility to new approaches in the current management system.

As noted above, the degree of consistency and consensus among participants on the issues and how they may be resolved was outstanding. There was a general feeling of accomplishment that the workshop had achieved its objectives, and that the proposed recommendations would lead to a new fisheries management paradigm. However, there is much work to be done, and the need for the momentum of the workshop to be maintained. For this reason, it was recommended that a steering committee be established to ensure follow-up of the workshop recommendations. It was suggested that the workshop planning committee could be a good starting point. It was further suggested that a similar workshop be conducted in a year.

Senior DFO Maritimes Region management are to consider the recommendations to determine an action plan for DFO. Stakeholder groups are also encouraged to consider the recommendations to ensure that the region can collectively move ahead on the incorporation of ecosystem considerations into fisheries management.

# 2.0. INTRODUCTION

## 2.1. Background

Two key catalysts have driven the need for this workshop. First, under Canada's new *Oceans Act*, the Department of Fisheries and Oceans (DFO) has an obligation to include ecosystem considerations into management plans. DFO is already moving in this direction, but the process remains to be strengthened. A second catalyst was the June 1998 announcement by the Minister of Fisheries and Oceans of a moratorium on all new forage fisheries in Atlantic Canada until a comprehensive policy on the management of these species has been developed and approved. By way of this workshop, DFO's Maritimes Region, has taken the first step toward the development of such a policy.

The workshop focused on ecosystem considerations in respect of fisheries at all trophic levels. Many species, including forage to predator species, are being commercially harvested, yet the importance of their position in the food web may not be known or adequately understood. There is a public perception that with fewer linkages as we move up the chain, the importance is diminished. However, this may not be so. It does not necessarily follow that species at higher trophic levels are protected if we protect forage species. This suggests the importance of considering ecosystem objectives within the present single species management approach. A more comprehensive approach to the inclusion of ecosystem considerations into ocean resource management is required.

## 2.2. Objectives and Scope

The objectives of the workshop were to develop concrete ways and means of incorporating ecosystem considerations into fisheries management and to foster communication and education of these concepts among all stakeholders. Both policy and operational aspects of the issues were explored. The scope of discussions encompassed all trophic levels, including existing and potential new fisheries but with a focus on Scotia Fundy fisheries and ecosystems. It was emphasized that DFO had no preconceptions on either the issues or the solutions, which needed to be defined collectively. The recommendations of the workshop will be considered by the Senior Management Committee (SMC) of Maritimes Region DFO for action. It is expected that the lessons learned here may be widely applicable in the rest of Canada.

## 2.3. Workshop Planning and Participation

Stakeholder involvement and input was considered paramount to the success of this workshop. To that end, a multi-sectoral planning committee was struck in November 1998 to ensure that the interests and concerns of key stakeholder sectors were incorporated into the workshop design and organisation. Invitations were issued to over 100 representatives from a representative cross-section of stakeholder groups. The response was very positive.

Representation was achieved from all targeted sectors, including federal and provincial governments, inshore and offshore fishing sectors, First Nations, the processing sector, universities and Non Government Organizations (NGOs), primarily from within DFO's Maritimes Region. A list of planning committee members and a directory of participants are included in Appendices 1 and 2.

### 2.4. Workshop Format and Structure

The workshop was convened over one evening and two full days (Appendix 3). On the first evening, a presentation was given by the DFO Assistant Deputy Minister (ADM) Fisheries Management, Pat Chamut, on the objectives of the workshop and its broader context within Canada.

On the first morning, invited papers were presented in plenary session on ecosystem issues considered relevant to the various stakeholder groups. The main themes in these talks were summarised during the coffee break and served as a focus for discussion in an open session that lasted the rest of the morning. Over lunch, a small group met to summarise the results of the morning discussions and develop themes to be discussed in working groups in the afternoon. Each participant of the workshop was assigned to one of seven working groups to ensure balance in their composition. Each working group was assigned the same themes and instructions for discussion in order to maximise "brain storming" and to identify commonalties in ideas presented by the different groups. The purpose of the working groups was to both confirm the issues that had been discussed in the morning and also recommends way to address these issues. Following dinner, representatives of each working group presented the results of their discussions in plenary session (Appendix 4).

The morning of the second and final day of the workshop commenced with invited presentations to the plenary on initiatives taken elsewhere to make an ecosystem approach workable, with particular emphasis on governance and implementation. Following these presentations, working group themes and instructions were developed in plenary. The working groups met in the afternoon and later presented their results in plenary (Appendix 5). Following this, there was a general discussion on all issues raised at the workshop before the workshop adjourned. It was agreed in this final plenary that the workshop steering committee would be used to finalise the proceedings, documented herein. These proceedings and their recommendations (Section 5.2) will be presented to the Maritimes Regions DFO SMC for follow-up action.

As stated above, each working group was designed to achieve a balance between all stakeholder sectors represented. Seven groups of around 10 to 12 people were set for the first full day of the workshop. It was the intention that the groups remain intact for the duration of the workshop. However, due to early departures on the final day, the number of groups was reduced to six by distributing participants from group 7 to the other groups.

A poster session was set up for the duration of the event, consisting primarily of selected posters from the March 1999 ICES/SCOR Symposium on Ecosystem Effects of Fishing, held in Montpellier, France, and reprinted with permission from the authors. Some reference material, provided by participants, was also placed on display in the poster session room. All poster titles, abstracts and lists of any reference material used at the workshop are provided in Appendix 6.

## 3.0. OPENING ADDRESS AND OBJECTIVES OF WORKSHOP

Pat Chamut
Assistant Deputy Minister, Fisheries Management
Fisheries and Oceans Canada

I would like to begin by expressing a warm welcome to all of the participants, and my personal pleasure at being able to introduce our discussions tonight. Our purpose here this week is to discuss the practical implementation of the ecosystem approach into our planning and conduct of Fisheries Management activities. This concept of ecosystem management is an extremely important advance in the continuing evolution of our program to achieve sustainable management and optimal benefit of our marine resources. The elaboration of this concept arriving at consensus as to what it means, and its translation into concrete actions represents a significant challenge for us all. I am optimistic that we will have success in rising to this challenge over the next two days, in view of the broad and diverse representation at this workshop.

We are fortunate in having participants from all stakeholder sectors including the harvesting sector and the processing sector, First Nations, academic community, representatives of Non Governmental Organizations and representatives from Federal and Provincial government.

My intent tonight is not to be prescriptive about our workshop topic. Rather, I want to provide some background to put ecosystem management in a broader context, and to highlight what it means domestically and internationally.

First, what do we mean by ecosystem management? It means that we need to move beyond management which focuses on single species. Our management must recognize that living organisms and their non-living environment are inseparably related and interact upon each other. Managing the fishery means more than ensuring that the harvest of a target stock is within the limit of acceptable mortality. The well being of the target stock depends upon the health and abundance of other species and upon the characteristics of the physical environment that sustains it. The ecosystem approach means that management planning must account for more than the conservation of single stock, without care for the well-being of other organisms.

Organisms do not function in isolation. The loss of one organism often results in the loss of many. Our management planning, and our execution of the plan, must be broadened to

explicitly consider and protect the structure and functioning of the ecosystem. The goal of the ecosystem approach is to restore and sustain the health, productivity, and diversity of ecosystems. We do this by managing what we take out of our marine systems, and what we put into them.

This concept of how ecosystems function is not new. We have known about the complex interdependence of species for a long time, and many of our management plans are increasingly taking this into account. However, we have not had the technical understanding to enable full implementation. In some cases, the will to take full account of ecosystem requirements has been lacking. But we have lacked the sophistication of understanding, and more importantly, have lacked the incentive, and the will to adopt an ecosystem approach. It is increasingly evident that we can no longer ignore the consequences of failing to address ecosystem inter-relationships. There are many examples of the consequences when we fail to protect the integrity of ecosystems.

Our earlier naïve misconceptions that the oceans are infinite in their bounty have been abandoned in the light of more recent experiences. Globally, we are increasingly exposed to the effect of man's activities on oceans resources. Over the past 25 years, the number of fishermen has more than doubled. Our technological sophistication has significantly increased our abilities to harvest more effectively, and to catch new species in new areas. Globally, we have not done well in managing what we take out of our marine system. As a result, 35% of the 200 main stocks of fish which have sustained global production are in decline, and 25% are estimated to be at their maximum yield.

World production of fish continues to increase, but growth in landings increasingly consists of lower value pelagic fish. There are concerns that we are fishing down the food chain, with significant long-term consequences for marine ecosystems. In addition to this increased assault of fishing activity, there is also an accelerated harvest of by catch – unwanted species that are discarded. It is estimated that about 25% of the world catch – which is approximately 100 million metric tons, is discarded. These concerns about overfishing and declines of fish stocks are not an abstract concern that faces people somewhere else. We have first hand experience with the collapse of groundfish stocks, and the associated cost and consequences for people in Atlantic Canada.

In addition to the problems associated with unsustainable harvesting practices, we are also having to cope with other impacts that are affecting the well being of marine ecosystems. Development in our coastal zone can have major impacts on the productivity of the marine environment. Pollution arising from discharge of human and industrial waste can dramatically affect marine ecosystems, and impair beneficial uses through the addition of nutrients, or the introduction of hazardous chemicals. There are particularly illustrative examples in the Great Lakes of how man's activities can dramatically alter the nature and functioning of an aquatic ecosystem. The Great Lakes also give us striking examples of another way in which we have affected the functioning of ecosystems. The introduction of exotic species can have a pronounced impact. The example of sea lamprey and more

recently, zebra mussels and the round goby, are useful illustrations of the consequences of the introduction of new species into our ecosystem. While these examples are from the freshwater environments, we need to be mindful that despite their greater resiliency, marine systems are not immune from these affects.

Managing in such a manner so as to protect ecosystem integrity is a sensible objective – but is more than just a domestic goal. It is also a key component of international agreements. Ecosystem management has been adopted as a fundamental principle in a number of international agreements. Canada is a signatory to the 1992 UN Convention on Biodiversity. This convention requires us to take measures to maintain and protect the diversity of life within an ecosystem. We are obligated to integrate the principles of this convention into our national policies and legislation. Government programs must promote the protection of ecosystems and natural habitats and the maintenance of viable populations of species in their natural surroundings.

Similarly, the FAO Code of Conduct for Responsible Fishing Operations requires the adoption of principles to maintain biological diversity and ecosystem integrity. The UN Fishing Agreement also includes principles with respect to ecosystem management. Canada ratified this agreement on August 3rd 1999, and assumed obligations to manage fisheries in accordance with those principles. These international obligations have been made explicit domestically through the Oceans Act, which provides a legislative commitment to ecosystem management, and adoption of the precautionary approach for management of our marine resources.

Finally, I want to mention impending legislation, which will affect our management policies and programs in a significant way. A legislative proposal for protection of endangered species is expected to be tabled in parliament during the next session. The adoption of an explicit obligation to protect species at risk will have profound affects on our resource management activities. Within Canada, we have been taking steps for some time to broaden and modernize our management approach to accommodate broader ecosystem objectives. We are controlling how we fish, not simply how much we catch. We have introduced measures to reduce by catch and discarding. Our management plans are focusing on selective fishing practices and by catch avoidance. The measures to avoid gear conflict with right whales in this region is a good example.

We are also addressing concerns about food chain effects of harvesting. We have a work group on forage species, which is developing national policy. We are also implementing new measures to protect sensitive areas by establishing Marine Protected Areas under the Oceans Act. This approach will ensure the safeguarding of habitat, which is critical for biological processes such as spawning, migration and rearing.

While we have made a good start, there is much more to be done. Our challenge is that while the concept of ecosystem management is clear, the ways in which we operationalize it are not. It is both timely and necessary to engage the dialogue that will allow us to collectively

identify the practical actions and next steps that are required for implementation of ecosystem management. We need to agree on what we mean by ecosystem management, and on what action is required for effective implementation. This workshop is designed to achieve that objective. The intent is to build consensus around strategies to build ecosystem considerations into fisheries management planning.

Our focus will be on Scotia-Fundy fisheries and ecosystems – but it is also my hope that the ideas can also be applied elsewhere. In these discussions, DFO has no preconceptions with respect to outcomes. Our intent is to collectively define issues, and develop a consensus on solutions. Our workshop program is designed to:

- identify issues and key themes for action;
- consider initiatives underway elsewhere from which we may learn; and
- develop recommendations on the specifics of how to incorporate ecosystem considerations into our planning.

As we approach this topic, we need to avoid getting bogged down by its complexity. We must recognize that we will not be able to define the "ideal" solution. What we need to focus on is an incremental, directional change, moving progressively toward an improved approach. Finding practical answers on how to proceed is vitally important for the future of the fishing industry.

The implementation of ecosystem management and the precautionary approach – two of the cornerstones of UNFA, and the Oceans Act – are essential strategies for ensuring the sustainable use of our marine resources. Canada has been at the forefront of global initiatives to ensure sustainable utilization of the ocean. It is important that we continue to show leadership in how this can be done at a practical level.

We are testing the limits of the resiliency of the ocean. If we are to both preserve the sea and continue to extract full benefit from it, we must moderate our demands, and more carefully manage them. The practical implementation of strategies that take into account the maintenance of biodiversity, and the productivity of marine habitat will represent a tangible advance in our stewardship of the ocean.

I commend the organizers of this event, and I appreciate the commitment of your time and ideas to this important discussion. I look forward to a challenging debate and productive discussion over the next two days.

# 4.0. IDENTIFICATION OF ECOSYSTEM ISSUES

## 4.1. Summary of Presentations

### 4.1.1 SWNB Industry Issues (Klaus Sonnenberg)

The Grand Manan Fishermen's Association and many groups in Southwestern New Brunswick want to continue to incorporate ecosystem management in fishery management plans. This does not mean, however, a new system that may or may not be invented but rather an acceptance of initiatives that have been identified from time to time. To fully understand our position, the Department of Fisheries and Oceans must accept that fishermen in general must be able to veto any new fishery initiative, in all species, that do not provide significant economic returns when threatening the viability of established fisheries. Our case in point is the proposed krill fishery, to which we have simply got to be able to say "no thanks."

There are three other examples that I would like to expand on:

1. The near shore closure of the scallop fishery except for January through March.
2. The protection of known sensitive areas such as the lobster nursery area in Flaggs Cove.
3. The question of salmon aquaculture.

The scallop conservation zone around Southwestern New Brunswick is an excellent example of how fishermen have initiated and lead government in their ecosystem concerns. In this case, the physical dragging activity threatened the viability of our lobster resource, which is prevalent in new shore areas during summer months. At a time when the scallop fishery was exceptionally lucrative, our fleet quickly realized that their activities up to the opening in November resulted in significant losses and that we would need to readjust the timing of this fishery to gain maximum benefits from both species.

In the case of the lobster nursery area, we watched helplessly as a controversial aquaculture site pushed large berried females out of a nursery area. Even though their migration was verified, DFO did not help us in our demands to remove the offensive site. Fortunately with the help of a local ferry operation, the site was moved and the lobster returned to their traditional area for successful contribution to the lobster fishery.

At this time, there are lawsuits on the west coast and numerous concerns regarding ivermectin and other pesticides, both legal and illegal, in the aquaculture industry. We see very little leadership from the Department in the protection of traditional fisheries and the environment from an overzealous provincial administration that has been proven to be careless in their management of the aquaculture industry.

We support the concept of ecosystem management but we believe that we have ample opportunity to include ecosystem concerns in our present management scheme. We do not

need university professors to tell us how to manage our fishery but we do need a commitment from the Department of Fisheries and Oceans to take seriously our concerns in many matters that clearly impact valuable commercial fisheries as they exist today.

4.1.2. SWNS Industry Issues: Ecosystems and the Fishery of the Future (Evan L. Walters)

Welcome ladies and gentlemen and thank you for the opportunity to make this presentation today. Time and events have and are moving us more directly into an ecosystem management approach to our ocean resources. Increasing human demands and expectations, changing environments, and our pursuit of ever more previously unharvested resource species will demand more cautious long-term planning. It has become apparent that a piecemeal approach to management of the fisheries is not a viable option.

Human ingenuity and need will constantly force an expansion into the harvest of more and more species in the waters of Atlantic Canada and around the world. Krill and silver hake are an example of this new Canadian interest. We live in a changing world where nature and humanity generated impacts are becoming more evident as each year passes. These changes to our environment are gradually becoming more pervasive and the effects on the multitude of species are more noticeable and dramatic each year. In 1998 dogfish, virtually disappeared from the waters off Nova Scotia as did white hake. In 1999, dogfish in our waters are very abundant and in numbers that are as high as ever observed, contrary to the American scientific view that the stock is in trouble. White hake, while not exceptionally plentiful, are widespread and available to catch. Halibut are appearing in greater numbers and age classes than have ever occurred in past years. To carry this farther, haddock, a mainstay of the inshore fishery, is not being taken and is not easy to find. What happened from 1998 to 1999 when haddock were very plentiful, especially younger fish?

Can we lay all blame on water temperature variations? While warmer water is being seen more and more frequently in winter and summer in many areas, is it the culprit that explains these changes to migration patterns and species availability? Where does global warming play its part? What of El Ninos which now occur more frequently and with greater impacts as time passes? If global warming is a serious problem, how will we measure the effects on the movement of species between seasons, traditional grounds and migration? What effect will an increase in air and water temperature have on the reproduction of species, what of rising water and increasing tide ranges? The ice cap, according to a report several years ago, has shrunk an average of 14 feet in thickness. That is a tremendous amount of water added to our oceans. It changes tides, major current flows along our coastline and certainly alters the productivity of the myriad species that inhabit our waters, both positively and negatively.

For fishermen, changing water temperature, currents and migrations, that effect the availability of needed commercial species and the prey species, may be adapted to if the changes are not excessive and involve only changing fishing areas or distance to be traveled. Any species that changes their traditional habitat or migration patterns will have a measurable impact on many other species that are interdependent and closely linked within

their lifecycles and the economics of the fishing community. An example may be herring spawning and lobster health. The presence of dogfish in large numbers from year to year will have impacts on the predation of juvenile fish, recruitment and stock recovery and other prey. An example may be the impact of excessive seal populations in bays and estuaries and the declining numbers of salmon, gaspereau and eels. Cod biomass in NAFO Division 4VW may be at risk because of grey seals in unwarranted and unusual numbers.

There are natural phenomena appearing cyclically throughout the years that are a progression of events leading to short-term changes of a few years, as we observed in the decline in weight and length at age in 5Z cod for a recent three year period. We recover from these variations and move on. Each change in nature has an effect that tends to offer some alternative harvestable species throughout the change period when nature attempts to fill a vacuum.

These events do not take into account the debilitating effects of human activity on specific species by harvesting practices and air and water quality changes. The drastic impacts of persistent organic pollutants and the relocation of species into or out of our waters by offloading ballast waters from marine vessels is now reaching disastrous economic and environmental proportions. For example, zebra mussels, goby fish, ozone depletion, habitat alteration and outright destruction and alterations like causeways. Poisons are frequently and freely dumped into living ecosystems.

From a fisher's viewpoint, herring is a major player in the health of most commercial species and often the lack of their presence has a major impact on movement and health of many commercial species.

Overfishing or environment may explain differences in annual movements of species but another emerging view is that there are many species, like herring and haddock, that are area imprinted and where they return each year as a part of an area ecosystem unless harvesting pressure has virtually eliminated that stock. Herring in Barrington Bay, Shelburne Harbour and Port Latour Harbour are an example of this where no fishery or migration has occurred for many years. Overfishing can destroy a complete area stock structure. The error is compounded through lack of knowledge of fishing impacts, area linkages and instinctual behavior.

Given the changes that are occurring in world conditions; economic, natural and human, it would be logical to take an apprehensive approach, and I use the word apprehensive, advisedly, for us to prepare accordingly. Through dedicated research, anticipation and study, it may well be possible to anticipate, prevent or prepare for the changes that we undoubtedly will face in the future. Climatic changes are going to have dramatic impacts on the species we are dependent on. An example of species changes could be changes to abundance and habitat for capelin, shrimp and crab that we have experienced in Atlantic Canada. Many of these changes can be attributed to environment.

The proper analysis of human interference and the deposition of toxic substances on reproduction of many species may well guide changes to our practices that would have benefits for a continuing fishery. Evidence from other parts of the world has clearly linked dangerous pollutants and accumulations of substances to fertility and reproduction failures or decreases.

It would seem apparent that we should be searching for the presence of substances that alter natural cycles. If we look at DDT and its impacts on raptor populations, thalidomide on pregnant mothers, dioxin and furan on killer whales in BC and beluga whales in Quebec, obviously the effects and their cumulative presence cannot be ignored.

In a world where species disappear forever, hourly, can we afford to ignore studies that may save us and our livelihoods? Can we justify saving money at the cost of losing what our communities and our fishers have followed traditionally for hundreds of years? The cost of the studies and research may well be insignificant compared to the loss we may all suffer if we are taken unaware. I would hope that none of us in this room today are comfortable with the events that are unfolding in our rapidly changing and diminishing world. I would also hope that crisis management is not an acceptable solution to new events when compared to preparation and knowledge. It is not enough to say; "I cannot" rather we should say: "we must!" Thank you for your attention and participation.

### 4.1.3. Ecosystems Approach To Fisheries Management: A View From The Eastern Nova Scotia DSAB (Kelvin Hussey)

To speak about issues in ecosystems management, there are of course the obvious issues that come up over and over again: predator-prey relationships; and affect of certain fisheries, and especially certain gears, on habitat. However the greater over-riding issue from our point of view is really how do we evolve from the current regime of single species management to an ecosystem approach?

Inshore fishermen, and their organizations, have to think in terms of the ecosystems from which we derive our livelihoods. We really count on multi-species, rather than count on just one species to provide all of our living. While one species may appear to be of dominant importance, others are important supplements. And we may depend on bait species as well, for the species that we sell. We have seen lobster take on more importance, for instance, since the demise of our groundfish fishery. Snow crab is becoming more important, as is shrimp. At the same time, mackerel and herring are important in the mix of commercial fisheries here, as well as being extremely important for bait in the other fisheries. There are other species, such as swordfish, which are not regarded as very significant in our area recently, but were very important here a few years back.

What inshore fishermen, and their organizations, would really like to see come out of a forum such as this, is a new approach of co-operation between us and scientists and managers. How can we really begin to evolve to ecosystem management without involving

all of the players, and looking at all of the issues as they arise in management decisions? Can we get away from regional or national policies, to decisions made at the area level, patiently involving all of the players – that is, the fishermen, the scientists, and the managers – to the best of our abilities? That is, I believe, the single biggest issue.

4.1.4. Offshore Sector Issues: "Ecosystem Issues from a Practical Perspective" (Michael O`Connor).

In December 1997, I attended a workshop sponsored by the Environment and Ecology Committee of the Fisheries Resource Conservation Council on moving "Towards an Ecosystem Approach to Fisheries Management." I entered that workshop with a vague notion of what an "ecosystem approach" would be, but left no further ahead. At that time, I recall concluding that the concept of a marine ecosystem was very difficult to define because of its complexity. There were also strong advocates present at the workshop promoting an ecosystem approach in the context of coastal community self-management, which made me suspicious that this approach meant reallocation. There was also the notion that several of our fisheries were already being managed with an ecosystem approach in mind - for example, the use of the Nordmore grate in shrimp fishing to exclude some groundfish, the use of groundfish midwater trawls to avoid bottom feeding groundfish, the use of closed seasons to avoid fishing on spawning cod despite available haddock, the use of grates in silver hake fishing to avoid bycatch, the prohibition of carrying dual gear to prevent targeting pollock with perch gear, etc. In hindsight, the list of exceptions to managing on a single species basis is even more extensive. We should take the time to develop such a list on a fishery by fishery basis. We may be further along with this approach than we realise.

Hopefully at this workshop, we can put a finer contrast on the issues and come away with a better understanding of an ecosystem approach. I think there are three fundamental issues, which need to be discussed about the concept. Firstly, who will pay financially for acquiring ecosystem "knowledge". Secondly, what is the process for public consensus and government decision making. Thirdly, how will this concept effect our operations broadly, and as individual fishermen and processors.

*Who Pays?*

The acquisition of ecosystem knowledge will likely be an expensive undertaking. We are dealing with complex interactions around various species over the food chain with variable habitat conditions. Co-ordinating current scientific research activities may help but will not address future requirement. For instance, a study of the eastern Scotian Shelf on juvenile groundfish foraging, which we were almost involved in, would have cost in excess of $ 200,000. That's only one species and stock area.

There are four obvious options to consider to fund ecosystem research:

(1) the government could increase public funding for research on ecosystems
(2) DFO could reassign funds from existing programs to ecosystem research activities
(3) DFO could, keeping with the precautionary approach, require industry to fund all or part of this research through direct or indirect means, and
(4) Some combination of two or more.

There are several exhibits (presented at workshop) that we should consider in assessing which options might best address the question.

a) A March 24, 1999, letter to the Minister from the Chairman of FRCC, Fred Woodman (on Erosion of Science Funding).
b) The increasing complexity and responsibility of DFO's science job.
c) Actual and estimated public funds available for science activities.
d) The industry's ability to absorb additional cost and/or pass them on to the market.

My conclusion from this information is that we are probably facing option 4 and that DFO science research funds will likely be spread too thin to effectively accomplish needed research and the industry will be "requested" to help. However, it is widely known the fishing industry has little, if any, ability to pass on new costs, hence, gross margins must be reduced. We are operating in a global market where the industry has little or no influence over prices. Any attempt to increase prices beyond competitive levels will be met with a decline in demand. It is also unlikely that an ecosystem approach will permit fishermen to become more efficient to absorb more operating costs. Clearly, the setting of science priorities will be critical.

*What Process?*

As indicated earlier, management measures in Atlantic Canada in many fisheries have been evolving along an ecosystem approach for several years. Albeit, not under any co-ordination regime or consistency from DFO region to region. By focusing on all ocean activities, the number of users and interest groups has multiplied from a DFO perspective. There is no formal process for all these groups to debate and form consensus, nor is there a fair and transparent decision making process. This doesn't mean there is no process in place, which reflects the political and social dynamic of the Atlantic fishery. For example, the northern shrimp fishery is conducted using the Nordmore grate, which substantially reduces the bycatch of groundfish species. However, small perch and turbot can still pass through the grate and become an incidental catch. In periods of large recruitment, this may have impact on future perch or turbot stocks; species important to us but with much less economic importance to industry in Newfoundland than shrimp. Obviously, choices have to be made. Socio-economics plays a very strong role in defining our ecosystems.

Closer to home, the grey seal population around Sable Island has been growing more noticeably since man, as a predator of cod, has been removed from fishing in the area early in the 1990's. During this period, we also learned that 4Vs cod recruitment has remained stable,

but for some reason, fish are not surviving to the adult stage. Now, I don't want to get into a debate about seals and cod today, but at what point, in what forum and with what research, can we come together to develop consensus and meaningful decision making. How can we strike a balance between our socio-economic needs and the ecosystem?

One final example to illustrate the need for a process involves resident cod based in 4Vn. This probable stock is in poor condition. As such since the early 1990's, fisheries for migrating cod, pollock, perch and flatfish in the area have been prohibited for all or part of the year and to some gears. Despite efforts to develop industry-sponsored research in the area, the only process that exists is confrontation and political pressure.

Clearly, we will also need a process to advance an ecosystem approach, which will address issues such as bio-diversity, MPA's, research priorities and economic viability.

*What about Operations?*

The industry is already heavily controlled and burdened by government through licensing and conservation harvesting plans. Using offshore groundfish as an example: there are fifty-four separate conservation and management clauses in the licence for captains to follow including, but not limited to closed areas, provisions for daily hailing and hailing upon landing, mesh sizes, species and amounts to be caught. In the sector's Conservation Harvesting plan, there are forty-five separate conservation measures to follow which are not covered by licence including bycatch provisions for non directed species, small fish protocols, catch monitoring and test fishing, seasonal and spawning and juvenile closures.

Our industry has responded to these challenges and will continue but we need to safeguard our investments and ensure we maintain economic viability in fishing. The more restriction on fishing operations, the more complexity and cost there is to fishermen and processors. This will invariably mean higher prices to a value conscious market and stiff competition from other food suppliers. Some of these concerns are short term and, over the long term, benefits from an ecosystem approach may pay off but who will benefit and what will it cost. To what extent do we restrict ocean use activities with ecosystem objectives in mind. For example, shrimp eat cod spawn, American plaice consume shellfish, the Emerald Bank closed area is creating flounder habitat possibly at the expense of haddock. How far do we go in an ecosystem approach? For the fishing industry, costs and benefits will have to be weighed carefully. Thank you.

4.1.5. Non Government Organization (NGO) Issues - CCNB's Perspective on Ecosystem Approaches to Fisheries Management: A Community-based Ecological Approach (David Coon).

1. Management goals for the public good
   a. Protect and restore ecological integrity and biological diversity of marine ecosystems
   b. Sustain and revitalize coastal communities

2. Managing for unpredictability
   a. Ecosystems are unpredictable
   b. Fishing activity is unpredictable

3. Communities, natural resources and ecological processes are interdependent
   a. Healthy ecosystems are the foundation of healthy fisheries
   b. Healthy communities are the foundation of productive, healthy citizens and societies
   c. Complex interdependencies of the marine ecosystem and coastal communities have evolved since first settlement
   d. Management approach must link ecology with community.

4. Principles of community-based ecological fisheries management
   a. The ecological integrity of the marine system must be restored and maintained
   b. The harvest of commercial species should be managed based on their particular lifecycles and biology
   c. Fisheries-dependent communities should hold trusteeship of adjacent fishing grounds and fishery resources
   d. Fisheries management should be placed in public hands at the community level, not privatized to individual/enterprise interests.

5. The ecological integrity of the marine system must be restored and maintained
   a. How does a fisheries management regime ensure that human activity, both fishing and non-fishing, does not fundamentally change the marine ecosystem which supports fish production?
   b. Ecological fisheries management requires that new approaches to fishing must be combined with new approaches to coastal zone management
   c. Protect critical habitats
   d. Ensure food supplies are not compromised
   e. Maintain ecosystem composition and structure
   f. Protect ecological functions
   g. Management based on an understanding of basic ecological processes responsible for origin and maintenance of organisms, habitats, benthos
   h. Ecological processes themselves must be conserved

i. Includes physical process and plant and animal activities which influence the state of ecosystem and help maintain its integrity

6. The harvest of commercial species should be managed based on their particular lifecycles and biology
   a. Maintain food availability in space and time
   b. Maximize reproductive success
   c. Build in inefficiencies through such things as controls on gear and imposition of seasons

7. The management unit
   a. Management must occur simultaneously at various scales
   b. Ecosystem scale (e.g. Bay of Fundy), cross boundaries (e.g.Gulf of Maine): informed by ecological marine classification
   c. Local scale: historical fishing grounds

8. New institutional arrangements required (i.e. Publicly accountable - transparent – democratic)
   a. Local management boards: geographically defined by fishermen in the context of their communities and traditional fishing grounds
   b. Bioregional or Ecosystem boards: constituted by local management boards
   c. Offshore boards

9. Research to support ecological management
   a. Science driven by management boards rather than managers
   b. Integration of scientific knowledge with local ecological knowledge
   c. Where have all the ecologists gone? Gone to stock assessment or aquaculture development- everyone? Can this trend be reversed?

10. Fisheries-dependent communities should hold trusteeship of adjacent fishing grounds and fishery resources
    a. Transfering wealth from the federal public domain to the local public domain rather than to the private sector
    b. Requires publicly accountable institutions at the local level to serve as trustees
    c. Puts responsibility for the public resource that is more directly dependent and therefore vested in its long-term health

11. Fisheries management should be placed in public hands at the community level, not privatized to individual/enterprise interests.
    a. Community responsibility to manage both the resource and its environment within its geographic jurisdiction
    b. New community and regional institutions required to oversee fishing, conservation and habitat protection

c. Community Fisheries Board, Ecosystem or Bioregional Fisheries Council, Offshore Fisheries Board
d. Local ecological knowledge can better be integrated into management decision- making
e. Ecological management requires an understanding of local ecological mechanisms and events
f. Rules for managing fishing effort to be developed by fishermen in the context of their communities
g. Much higher level of compliance results

12. A climate for change?
    a. Will community-based ecological fisheries managment initiatives be given the opportunity to be piloted?
    b. Is there the institutional will for change at DFO?
    c. Is there political will for change?

Some Thoughts on Principles of Ecosystem Management from Dr. John C. Gordon, School of Forestry and Environmental Studies at Yale.

*Some Definitions*

Ecosystem: a bounded space pervious to energy but not mass with transit and transaction of both accounted for. Mass goes in and out but must be accounted for. Ecosystems are areas with intrinsic properties, e.g. watersheds, lakes, other bounded spaces (i.e.Gulf of Maine).

Ecosystem management: people trying to accomplish something in a bounded space, where management focuses on inputs, interactions, and processes as well as outputs.

*Simple Ecosystem Management Principles*

1. Manage Where You Are: EM applies to a specific site. Emphasis on the properties of the place to be managed and the objectives for which it is managed.

2. Manage With People in Mind: each system definable in biological and physical terms connects to and interacts with a network of human values, uses, institutions and other social structures.

3. Manage Across Boundaries: track transactions across defined system boundaries and moves boundaries when necessary. Neighbour influences must be recognized and managed at the very least.

4. Manage Based on Mechanisms rather than Rules of Thumb: Knowledge of the specific processes and interactions responsible for system activities and outputs is the key to improving ecosystem management.

5. Manage Without Externalities: all known contents of the system be included and considered when decisions and manipulations are made.

*Parting Thought*

To monitor a system adequately and understand the local mechanisms is labour intensive and time-consuming.

4.1.6. DFO Perspective on Ecosystem Issues (Mike Sinclair)

The Canadian Oceans Act passed in 1997 entails new obligations for oceans management. Fisheries are to be managed within the broader context of integrated ocean management of the aggregate ocean uses, ecosystem features are to be considered, and a precautionary approach applied. In response to the Act, the Department of Fisheries and Oceans has initiated discussions on the approaches to be taken. For fisheries biologists, there are two categories of challenges; 1) a new scientific perspective on conservation objectives, and 2) a complication in governance. Ocean Management Areas (OMAs) need to be defined based on required stakeholder involvement for the diverse management activities, as well as the artificial boundaries of political and administrative systems already in place. The fisheries (and other industrial activities) within OMAs will need to be evaluated in relation to properties of ecosystems as well as of the target species. Ecosystem objectives need to be defined in parallel with the presently used conservation objectives of fisheries management plans. The new objectives need to address biodiversity and habitat productivity. Associated with the ecosystem objectives, performance measures and reference points need to be defined. New monitoring activities and data products will be required for the performance measures. Implications of incorporation the ecosystem objectives of an OMA into present management plans are outlined. Evaluation of the degree to which aggregate industrial activities are meeting ecosystem objectives, and resolution of user conflicts requires changes in governance. The nature of consultation between fisheries scientists and stakeholders will change. Some aspects of these changes are described.

4.1.7. Ecosystem Management: International Perspective (Jake Rice)

In this talk, I present a partial overview of what major activities are going on internationally, with the objective of making progress on taking an ecosystem approach to marine resource management. I focus on two ends of what may be a continuum in at least capacity to take action on ecosystem management - efforts in developing countries, and efforts in Northwest Europe. For both cases I review both activities by groups which are addressing the policy aspects of ecosystem management, and by groups which are implementing the programs.

In developing countries, United Nations agencies are the foci for policy initiatives, either through multinational programs or capacity-building in member states. The United Nations

Environment Program has promoted major policy initiatives, such as the Global International Waters Assessment and the Global Biodiversity Assessment. However, the United Nations Development Program has also been proactive in taking an ecosystem perspective on coastal development initiatives. In all these cases, the fishery is not viewed as a separate activity, to be made more ecosystem friendly. Rather the focus is on viewing all the activities which perturb marine ecosystems together, looking for both positive and negative synergies in effects of actions.

Internationally the Global Environment Fund (GEF) and the UN Food and Agriculture Organization (FAO) are major players in program implementation and on-the-ground capacity building. GEF funding is particularly crucial, and GEF has coastal and marine ecosystem management identified as a major priority. This has led to at least 10 coastal or Island State Biodiversity projects, 20 Strategic Action Plans, and 15 Large Marine Ecosystem evaluation projects. GEF pilot projects generally are funded at $1-10 million (US), with a strong sustenance focus for fisheries activities. Major FAO initiatives include the State of the World Fisheries and Aquaculture assessments, the Code of Conduct for Responsible Fishing, and the Rome Consensus - which has several provisions addressing ecosystem effects of fishing.

In northern Europe, the major policy initiatives come from the Intermediate Ministerial Meetings (IMM) and the EC Common Fisheries Policy. International Commissions delivering the programs include OSPAR (the Oslo and Paris Commissions) and HELCOM (Helsinki Commission). Scientific support is provided by ICES (International Council for Exploration of the Seas).

The 1997 IMM meeting endorsed a series of conclusions on Integration of Fisheries and Environmental Issues, including conservation of biodiversity, sustainable use of ecosystem components, and a precautionary approach. Integration was to be based on identification of ecosystem processes, considering multi-species interactions, and integration of ecosystem objectives with viable fishing industries. At a technical workshop on implementation strategies for the IMM conclusions, the role of ecosystem objectives and integrated biological, physical, social, and economic assessments were stressed. It was also noted that there is currently insufficient information to fully implement an ecosystem approach to the North Sea, and that it is impossible to manage the North Sea towards some predetermined state. However, it is feasible with current knowledge to achieve sustainable use and protection. Over a dozen specific strategies were provided for action on implementing an ecosystem approach to management of the North Sea.

OSPAR was created by convention in 1992, for the protection of the environmental quality of the Northeast Atlantic. Its enabling documents require application of the precautionary approach and the polluter pay principle, and assure involvement of NGOs in OSPAR activities. It has become active in some fisheries issues through its holistic mandate for the marine environment. Activities include regional and zonal Quality Status Reports, and

workshops towards developing guidelines for habitat classification systems, marine protected areas, bycatch regulation, and metrics of ecosystem status.

### 4.2. Summary of Issues

To stimulate discussion, during the morning coffee break, the workshop Chair summarized the major issues raised during the morning presentations. These included (in no order of priority):

- Incrementalism: we must take one step at time;
- We should build on what we have;
- Communication is an essential ingredient - particularly in relation to how industry association representatives or community leaders can 'sell' the concepts to their membership and peers;
- Ecosystem management is broader than fisheries management (environment, pollution, oil and gas development);
- Adaptation of national policy to local level with community/user input is essential;
- Science challenges and financial realities must be recognized and addressed (government and industry);
- The benefits of short-term pain versus long-term gain must be appreciated;
- Management units and governance need review and revision; and
- Objectives, performance measures, reference points need defining.

Discussion in plenary then ensued. Most agreed with the points but added the following:

- It is essential that we implement some measures now within the context of existing legislation and information: waiting for a major strategy/national policy could prove too late;
- Clarification was provided with respect to Fisheries Act – sections 35/36 dealing with discharge of deleterious substance into federal waters: in 1979, responsibility for administration of those sections were delegated to Environment Canada, under the authority of the Fisheries Act. Development and implementation of related regulations falls under the jurisdiction of Environment Canada (EC), not DFO.
- A consistent theme throughout the morning presentations included the need to look at processes for balancing differing interests, developing consensus, and decision making.
- A distinction was drawn between the precautionary principle (adopted in the context of toxic contaminants and human health & safety, requiring action if any risk is posed), and the precautionary approach (which allows the inclusion of socio-economic facets into the decision making process, and pre-supposes that standards for ecosystem health exist). Canada is committed to the precautionary approach in both domestic and international fisheries, however, indices need to be agreed upon especially by those whose lives will be affected by them to further progress;

- Definitions must be broad enough to encompass the ecosystem concept: e.g. "sustainability" must mean more than sustainability of a target species;
- The degree to which we are already meeting ecosystem objectives should be recognized in discussions (i.e. building on what we have).
- An ecosystem approach to fisheries management essentially revolves around managing human activity, hence human need from their environment will govern their behavior toward it. "Rules of good behavior" are not always observed: if unfairness is perceived, compliance will not occur;
- Adaptive management, associated with adapting to a changing social and natural environment, requires "managing unpredictability";
- A dollar value cannot be put on the intrinsic value of natural resources and the environment;
- Biodiversity and species at risk issues are going to change the playing field for fisheries management. Users have tremendous capacity to help bureaucrats garner information and input on how to deal with these issues. Pressure will be on bureaucrats to act if users/stakeholders contribute or not.
- One of objectives of the workshop is to develop recommendations to stakeholders. How will this be followed through? There is the real concern that many previous initiatives have not been effectively implemented owing to the negative impact on economic viability of activities. For instance, $2B was spent on TAGS and not on how to make fisheries more sustainable.
- There is a need for more ecological research to be included in science challenges, both inside and outside of government.
- The practical knowledge of the fishing industry must be brought into decision making.
- An analysis is needed of what isn't working and why (e.g. finfish and salmon aquaculture. Salmon – initial purpose was to enhance wildstocks - but this has not proven to help). There is a need to revisit past decisions on resource management.

### 4.3. How To Address The Issues: Summary Of Working Group Reports

Over lunch on the first day, a small group of workshop participants was convened to develop instructions for the afternoon working groups. The issues identified in the morning session (section 4.2) were categorized into six major themes suggested by the workshop Chair, these being Objectives, Strategies, Regulations or Tactics, Monitoring & Research, Decision-making and Information Gathering. The issues identified by key theme were:

*A. Objectives*

- Objectives for ecosystem considerations – start with ecosystem impacts
- Biodiversity and habitat productivity
- Balancing of ecosystem considerations with human activities
- Need to place a value on the components of the ecosystem

*B Strategies*

- Adaptive management approach
- Precautionary approach
- Operational targets to guide ecosystem ‘management'
- Need for reference points and performance measures for biodiversity and habitat productivity (impacted and linked species) and ecological processes

*C. Regulations or Tactics*

- Fix what is broken now
- Assess what is working and what is not
- How to promote compliance (who and how) – need to regain user confidence

*D. Monitoring and Research*

- Develop a system to value the components of the ecosystem
- Need more ecological research
- Need to use all sources of knowledge – requires data protocols
- Need to monitor non-fishing impacts
- Need to monitor and assess if ecological reference points are being achieved
- Risk analyses needed

*E. Decision-making*

- The definition of the management unit
- Governance structure for incorporating ecosystem considerations into management
- Need for cooperation among jurisdictions
- Adapt national policy to local level
- How to conduct decision making with conflicting interests
- How fast (or if at all) do we adopt ecosystem approaches
- Communications and stakeholder involvement/buy-in
- Need to evaluate short-term costs versus long-term gain
- How do you incorporate species plans within ecosystem plans

*F. Information gathering*

- Science challenges of funding to meet new monitoring and reference point definitions
- Industry challenges to contribute to the funding of research
- Cooperative approaches to research – how to facilitate

These issues were then distributed to the working groups, with instructions to not only consider the completeness of the list of issues but also, most importantly, to consider how these could be addressed. It was the intent that these ideas would be developed into recommendations for actions on the second day of the workshop. Detailed reports produced by each working group are included in Appendix 4. Their deliberations are summarized below by key theme.

*A. Objectives*

There was agreement across all break-out groups that an accelerated move toward incorporating ecosystem considerations into fisheries management is desirable and that defining specific objectives will be necessary for facilitating and guiding this process. The objectives set should consider both biological and socio-economic facets of the fishery, and indeed, extend to and require buy-in by other ocean users.

Biodiversity and habitat productivity objectives, performance measures (quantitative and qualitative) and reference points were generally endorsed as an operational approach, though this should be preceded by developing a common understanding of the terminology. Some groups identified the need to narrow down the scope of biodiversity and habitat objectives to specific stock components, species or defined habitat by species (or else, as one group put it, "make the world safe for sea lice"). This can include reference points for indicator species as well as target species. An even more pragmatic suggestion was made to build on present conservation objectives in existing (single species) fisheries management plans as a means of incorporating ecosystem considerations. Finally, several groups debated the issue of where the "starting point" is in terms of an ecosystem state and related objectives. There were several suggestions that we should not just be managing the status quo, but engaging in ecosystem restoration activities as well.

A clear majority, notably four of the seven groups identified and fully supported the need to balance ecosystem considerations with human activity – i.e. fishing industry viability must be considered in setting objectives. A fifth group also identified the same issue, but there was no consensus within the group in support of this objective.

*B. Strategies*

The Precautionary Approach was widely preferred over the Precautionary Principle as a key management strategy. While there was some discussion of revolutionary versus evolutionary approaches to the required change, five of the seven groups identified and fully supported the need for an incremental, cost effective and adaptive management approach – i.e. we should not discard what works, but expand and diversify what we do now to include targets and reference points for other parts of the system. For instance, existing management plans could incorporate life history, by-catch, forage aspects, other trophic levels, other impacts (acid rain, climate change, other activities/factors such as aquaculture) and linkages with other target species and this, by geographic area. In addition, habitat RAPs should be held on a

regular basis rather than being issue driven. Finally, RAPs should be used to define parameters of the management system.

Enhancing the role of local input should be an essential component of a new strategy. As well, government should be incorporating data from other sources, such as from fishermen (Traditional Ecological Knowledge – or "TEK"), NGOs, First Nations, and universities.

On a broader scale, we should strive toward a better integration of fisheries, habitat and coastal zone management. As well, there is a need for education and awareness programs. Users of the ocean need to be aware of the impacts their activities on the marine ecosystem. Participants recognize that this will take time and be evolutionary. The Code of Conduct for Responsible Fishing was identified as a possible appropriate channel.

*C. Regulations or Tactics (implementation)*

At least two groups emphasized the fact that significant measures are already being taken in some fisheries to reduce their impact on the ecosystem. Group seven went on to stress the need for industry to promote what they are already accomplishing toward this goal, but also recognized that industry must continue to become "greener". Measures should include continuously improving gear to reduce ecosystem impacts, reviewing and integrating appropriate regulations in light of ecosystem objectives, and finding ways of promoting compliance. A regulatory review should include both stakeholders and regulators to promote compliance. Three groups focused heavily on the compliance issue, one noting that we can't fully attain compliance now on a single species basis and that voluntary compliance will be necessary at least in the short term. This approach would further contribute to the "greening" of industry's image. We must assess what our ability is to promote compliance in an ecosystem context. Compliance may be promoted by enhancing "buy-in" through assignment of rights, responsibilities and accountability.

*D. Monitoring & Research*

It did not appear entirely clear how one "monitors an ecosystem". However, many specific means and products were suggested for long-term monitoring and research requirements. These include more long-term ecological research and reference points, mapping benthic habitat, and monitoring impacts on habitat and incidental mortality of both fishing and non-fishing activities. New data will be required to achieve these goals, but just about every group emphasized that much can be gained from accessing, evaluating and synthesizing existing data from all sources, be it pure science, TEK (Traditional Ecological Knowledge), NGOs, First Nations, etc… To that end, there is a need to make better use of information that already exists. This can be achieved by developing data exchange and access protocols not only for use by Science for monitoring and research purposes, but also for ensuring access to data and enhancing awareness by all stakeholders.

*E. Decision making*

The decision making process and accountability were viewed as key in successfully "selling" the ecosystem approach to stakeholders. Decision-making should be made at the lowest appropriate level. A conflict resolution mechanism must also be integrated into the process for it to succeed.

There were some references to a "nested" approach, which brings ocean users together with decision making as a goal, at varying spatial scales. The governance structure must extend to the setting of objectives. There is a need for both bottom up and top down decision-making processes, whereby species plans, operational plans, land use plans and so on characterize the local products, nested within a framework extending from the international, national and regional levels. Principles, approaches, guidelines, strategic direction, and legislation might characterize the top down products.

Consistent with the adaptive management approach suggested under "Strategies", the roles and responsibilities of existing boards, committees, councils, and government bodies or institutions should be reviewed in the context of an ecosystem approach to fisheries management. The need for ecosystem "councils" based on ecosystem units can then be evaluated over and above these.

*F. Information Gathering*

Funding was identified as a major challenge. To that end, cooperative approaches and priorities are essential. Industry was viewed as an essential contributor, both to data acquisition and financing. Corporate tax deductibility of ecosystem R&D would greatly facilitate industry's ability to contribute financially to this cause. An important issue to consider, however, is the possible proprietary nature of corporately acquired R&D data which might limit access to and use of data. Contributions by smaller organizations may be more difficult.

## 5.0. MAKING AN ECOSYSTEM APPROACH WORKABLE

### 5.1. Summary of Presentations

5.1.1. The Challenging New Approaches to Oceans and Coastal Management: Eastern Scotian Shelf Integrated Management (ESSIM) Project. (Glen Herbert, Scott Coffen-Smout).

This presentation raised awareness of DFO's work on oceans and coastal management under the *Oceans Act*, with particular reference to the Eastern Scotian Shelf Integrated Management (ESSIM) Project. It highlighted the philosophy, principles and approaches of oceans and coastal management, showing the reinforcing and interdependent nature of what

can be termed the *Oceans Act* toolbox. It provided consideration of how the principles of the *Oceans Act*, the ecosystem approach being but one, can come together to meet the challenges of more effective oceans and coastal management in Canada. As a major maritime nation and a world leader in oceans affairs, we have important responsibilities, obligations and opportunities in meeting these challenges.

*Overview of the ESSIM Project*

The ESSIM initiative was announced in December 1998 in conjunction with the Sable Gully MPA Area of Interest (AOI), and followed the recommendation of the 1998 Sable Gully Conservation Strategy that integrated management be applied to the larger ocean area surrounding the Gully AOI. The eastern Scotia Shelf is the first defined ocean management area with an offshore focus under the *Oceans Act*. In addition to enhancing the current efforts of DFO and its partners in the Sable Gully project, it complements other work in the region on coastal management issues, and will ultimately provide a practical example for oceans and coastal management in Canada. The ESSIM Project is being led by the Oceans Act Coordination Office concurrently with work on regional and national departmental frameworks for oceans and coastal management.

The ESSIM study area encompasses approximately 320,000 $km^2$, from La Have Basin to the Laurentian Channel, and out beyond the 200 nm Economic Zone (EEZ) to include future continental shelf claims under the 1982 LOSC. This area has been selected for the application of oceans management under the *Oceans Act* because it possesses important living and non-living marine resources, a high level of biological diversity and productivity, and multiple ocean users and activities with a number of existing and potential user conflicts. In addition to fishing, these uses and activities include offshore oil and gas, shipping, defence, submarine telecommunications cables, scientific research and development, tourism and, potentially, mineral development. Effective oceans management of the Eastern Scotian Shelf ocean area needs to address a number of issues, including resource depletion, ecological change, marine ecosystem health, and increasing levels of ocean use.

The objectives of the ESSIM Project are those of the *Oceans Act* itself. To fulfil the requirements of the *Oceans Act*, oceans and coastal management must be based on and incorporate the underlying principles of the Act, including an ecosystem approach, sustainable development, an integrated approach, collaborative approach, and the precautionary approach to decision-making. Based on this, the objectives of the ESSIM Project are:

- to encourage the conservation, effective management and responsible use of marine resources;
- to support the maintenance of biological diversity and productivity in the Eastern Scotian Shelf area; and
- to foster opportunities for economic diversification and sustainable wealth generation for coastal communities and stakeholders.

The first phase of the ESSIM project has resulted in an overview and use audit to set the groundwork for an Oceans Management Plan for the Eastern Scotian Shelf. This use audit has assisted in the identification of the key elements of oceans management in the Eastern Scotian Shelf area, including short and longer term objectives and actions, as well as roles and responsibilities for DFO and its many partners in the planning and implementation process. In particular, the use audit identifies:

- the principal ocean activities and stakeholders in the area, their interactions and relationships, as well as general considerations of ecosystem impacts;
- the present management and legal frameworks and mechanisms at play in the area; and
- the key oceans management issues affecting the area, such as problems of multiple oceans use.

*Oceans and Coastal Management in Canada*

The *Oceans Act* is enabling legislation that embodies the principles and approaches for oceans and coastal management developed internationally. The oceans and coastal management process is an on-going, inter-related approach. It must be based on a strong philosophy through the identification of objectives and principles. It requires on-going planning through the development of strategies, roles and tools for oceans and coastal management plans. There must be action in terms of operationalizing and implementing these plans; and throughout the process, monitoring and feedback must be used continually to assess results, and adapt, modify and improve the process and consequent actions.

The basis for the oceans and coastal management philosophy is simply that the underlying principles and approaches of oceans and coastal management -- the *Oceans Act* toolbox -- need to be understood, accepted and incorporated by all ocean sectors. The principles and approaches of oceans and coastal management include:

- Collaborative Planning and Decision-making, which requires that all interested and affected parties have opportunities to be involved. This entails shared responsibility and planning *with* stakeholders rather than *for* stakeholders.
- Sustainable Development, which is all about meeting our needs without compromising the needs and abilities of future generations.
- Integrated Management approaches, which require on-going planning and management processes through which decisions take into account ecological, human use and governance considerations.
- Ecosystem Approach, which is based on the essential recognition of the dynamic and complex nature of interactions among all ecosystem components -- living and non-living -- and including humans.

- Precautionary Approach must be applied to all aspects of oceans and coastal management. Here, we need to draw on experience in the areas of marine pollution and fisheries management.
- Adaptive Management which enables us to respond to change and improve the oceans and coastal management process.

*Making an Ecosystem Approach Workable*

The ecosystem approach is fundamental to maintaining biological diversity and productivity, as well as ecosystem integrity. The ecosystem approach is more than multi-species management. To be effective, it must be applied broadly to address and integrate the environmental, social and economic contexts of oceans and coastal management. From the broad perspective of oceans and coastal management, the ecosystem approach entails the continuous collection and synthesis of data on all components of an ecosystem leading to the adoption and implementation of appropriate management strategies and decisions.

What must be borne in mind is the reinforcing and inter-dependent nature of the oceans and coastal management principles provided by the *Oceans Act*. The ecosystem approach is only one of the principles, and must come together with the others to meet the challenge of the *Oceans Act*. The effective application of the ecosystem approach requires components of each of the other principles. The oceans and coastal management process is mutually reinforcing in nature.

One of the most important aspects of implementing the ecosystem approach is that of data collection and analysis. The continued development and use of information and monitoring technologies is key to this activity.

The operationalization of the ecosystem approach in the broader context of oceans and coastal management requires the use of various forms of remote sensing and mapping tools. In addition to providing the "big picture", visual tools such as geographic information systems (GIS) can effectively display information for all aspects of oceans and coastal management.

Specific indicators are needed to define and monitor the health of an ecosystem. Marine Environmental Quality (MEQ) standards are measures that provide objectives to be attained and maintained relative to the condition or state of specific ecosystem components. Indicators can be used to monitor progress toward ecosystem health objectives and as an indication of whether ecosystem management decisions are working.
Once important and sensitive areas have been identified, Marine Protected Areas (MPAs) are one option for protection. Within the Eastern Scotian Shelf area, the next step in the MPA Program for DFO and its partners is to work on conservation objectives and management measures for the Sable Gully MPA project.

Education and awareness raising serves to reduce misunderstanding and conflict, and the activity itself leads to cooperation among those involved.

The Ocean Use Planning concept of area-based management and zonation is one mechanism that could be applied to deal with multiple use issues in oceans and coastal management. Decisions could be based on layers of geo-referenced and time-sensitive information regarding ecological attributes, habitat sensitivity and ocean use.

Regarding improved Ocean Governance, building on existing management mechanisms where possible, management gaps and weaknesses need to be addressed creatively through both formal and informal management arrangements and approaches. A good example of this is compliance and enforcement, which must use an integrated mix of operational, political, legal and non-governmental approaches. The oceans and coastal management process is dependent on everyone working together and playing a role.

*Applications to Fisheries Management*

On the management side, integrated fisheries management plans (IFMPs) provide the means to achieve an ecosystem approach. As they evolve, they will need to be creative in addressing an ecosystem approach, including aspects such as trophic level interactions, habitat sensitivity and genetic diversity. Of equal importance is the role of the fishing industry stakeholders. The oceans and coastal management process must be used to enhance their participation and input.

The challenge of meeting the requirements of the *Oceans Act* applies to everyone of us in everything that we do in our ocean. As a world leader in oceans affairs, Canada must continue to take a lead role in meeting its international obligations and responsibilities.

5.1.2. Bay of Fundy Fisheries Council Initiative (Maria Recchia)

The Bay of Fundy Fisheries Council (BFFC), founded in 1997, is an umbrella organization encompassing 14 fishermen's Associations around the Bay. The Council was established to give fishermen in the Bay of Fundy a unified voice in issues affecting the Bay's ecosystem, fisheries, and fishing communities.

*BFFC Mission Statement***:**

To support fisheries management in the Bay of Fundy according to the following principles:

a) That the Bay of Fundy fisheries must be managed so as to ensure the sustainability of the fisheries in the Bay of Fundy ecosystem as a whole.
b) That the fishermen in their communities have the primary role in the stewardship and management of the resource and management decisions must be made at the most local level possible.

c) That the Council will be geographically based and driven by democratic, transparent, trustworthy decision-making processes and structures.

*BFFC Objectives***:**

To
a) Develop and implement a comprehensive ecosystem plan to be applied to the Bay of Fundy fisheries, with a primary focus on spawning and nursery areas, food species and habitat.
b) Encourage participation by all Bay of Fundy fisheries.
c) Support local management boards and facilitate the resolution of overlapping fisheries management issues.
d) Develop a research agenda, coordinate knowledge on Bay of Fundy fisheries and ecosystem and foster two-way interaction with the research community.
e.) Identify and address issues common to all member associations.
f.) Support membership organizations.

*Issues the Council has worked on:*

- Krill - the BFFC was a leader in the successful campaign to prohibit a new fishery for krill in the Scotia-Fundy Region.
- Right Whales - the BFFC is working with the Right Whale Recovery Team. Marine Mammal professionals have often come to the Council to ask for help on this issue.
- Shift of Effort in Groundfish - Some of our members have been working on this issue for 5 years. We see a real problem in the concentration of groundfishing effort in the Bay of Fundy, much of it from fleets that have not traditionally fished here. This is an ecosystem concern. This year the inshore Bay of Fundy groundfish fleet had their worst year ever.

*Writing the Rules Project*

The most recent initiative of the BFFC is the "Writing the Rules Project." This project is founded on the premise that current management is not capable of protecting the Bay from overfishing and environmental damage. Our members see dumping and discarding, fishing on spawn fish, concentration of effort on some areas wiping out local stocks where they may exist, increased privatization which diminishes ecological consciousness of harvesters, etc. etc. -- All of these things are damaging the resource.

The Writing the Rules project aims to design alternative management strategies for Bay of Fundy fisheries by talking to fishermen around the Bay in a series of kitchen meetings, regional meetings, and meetings with fishermen's associations (note the council is made up of associations and the decision-making process is based on the organization of fishermen in associations).

Through this process, we have come up with a plethora of ideas on how to improve fisheries management in the Bay. Invariably, this involves using an ecosystem approach. Fishermen are very skilled in thinking about the marine environment in terms of relationships. For example, quality, amount, and location of feed determines when and where to seek predators. In addition, currents, bottom type, and associated organisms all give clues to a successful harvest. Therefore, it seems natural to go to experienced fishermen for advice on an ecosystem approach to management or, as David Coon suggested, the more appropriate concept of an ecological approach to management.

Over the past several months, the project staff: Arthur Bull, David Coon, Joan Simms, and myself have been recording fishermen's ideas on good fisheries management in the Bay of Fundy. These ideas fit into a community-based management framework. It should be noted that the BFFC is not waiting for DFO to implement these measures for us, instead we hope that they will become operational in the community-based management initiatives of our member fishermen's associations.

We are in the process of developing principles of good fisheries management through this project. To date, the principles have been adopted by all but two of the fourteen member associations. The two outstanding are slotted to meet with their Boards of Directors soon to discuss final approval. Below, I will discuss some of the ideas contained in the draft principles of good management.

Two fundamental principles, which emerged from our project meetings, require that fishermen hold real authority in fisheries management and that management decisions be made at the most local level possible. The draft document describes the importance of having local community-based governance bodies where fishermen, through their associations, have the primary role in the stewardship and management of all adjacent fishery resources and the ecosystems that support them.

Several operative management principles involving both ecological and socio-economic concerns are also emerging from this process. On the ecological side, many fishermen cited the importance of protecting reproduction and juveniles through management. There is recognition that in many cases this involves maintaining critical habitat as well. Other ecological topics include maintaining food chain relationships and protecting local stocks.

Other ideas relate more to socio-economic concerns. There was a strong sense that effort controls should be favoured in management and that diversified fishing livelihoods should be promoted. Many fishermen felt strongly that their ability to participate in several fisheries helped to relieve fishing pressure on scarce species, since fishermen could switch their effort to another fishery. This is something that the single species professional fishing enterprises cannot do. The other issues, which are important to Bay of Fundy fishermen, include promoting owner-operated fisheries and retaining fish as a public resource (i.e., no privatizing fisheries). Fishermen want to ensure that future generations have an equal or better opportunity to access fishery resources.

In addition to these overarching principles, the BFFC is considering specific applications of the above principles. During the kitchen meetings with fishermen around the Bay many suggestions were recorded for specific management measures for each species. The majority of fishermen's comments emphasize the use of how, when, and where effort controls as opposed to quota controls in the management of most fisheries. It is important to note that fishermen are not disappointed with all aspects of the current management system. In fact several existing measures are emerging as keepers, especially in the lobster fishery.

There are two other components to this project, developing a research agenda to aid in community-based management, and developing a series of pilot projects to test out our ideas. One of the pilot projects will likely involve an Upper Bay ecosystem plan, which was developed 5 years ago with the help of Nancy Shackell and others.

*Next Steps*

1. Get feedback from the BFFC Advisory committee- made up of scientists, environmentalists, community development workers, provincial government employees, academics etc.
2. Get feedback from DFO scientists
3. Revise further and work towards ratification

*Conclusions*

Fishermen's organizations in the Bay of Fundy are taking an ecological approach to fisheries management. They are using common sense, and the expertise of people who have spent most of their life in the marine ecosystem. Perhaps that is where you should look to find ideas for appropriate fisheries management that ensure the viability of fisheries, ecosystems, and fishing livelihoods.

5.1.3. Bras d'Or Lakes Project (Cheryl Bérubé)

In recent years there has been an increased interest in the impact of human activity on our natural resources. The increasing exploitation of marine resources to feed the exploding population of the world has resulted in greater pressures on fish, shellfish and marine plant stocks. There has also been an increase in aquaculture for finfish and shellfish. Many of these activities directly or indirectly affect the quality of our fisheries. In order to minimize our impact on our fisheries we need more knowledge about the ecosystems, both of the oceans and their watersheds, and how they work. Because of our lack of information, we cannot know how the exploitation of a resource may effect the environments as a whole.

The Eskasoni Fish and Wildlife Commission has for the past eight years been involved in habitat assessment and improvement. We have also worked to increase aboriginal access to the fisheries sector. Over the years we have developed various programs to deal with the issue of fisheries resources and the effect human activities have on the ecosystem. For

instance, we improved the habitat for Indian Brook River and have seen salmon return to the river. We have participated in various scientific studies that have looked at the populations of herring and lobster in the lake, as well as some of the physical oceanography of the lakes. The herring study has looked at their population as well as their breeding status in the lake, but little work has been done concerning the overall environment where they live. It is also unknown whether the Bras d'Or Lakes herring are a distinct population as compared to ocean going herring, or if they are the same as the ocean population. An increased knowledge about the herring and how they interact with their environment will allow us to use the resource in a more sustainable manner.

In order to answer the many questions that we have about ecosystems, there have been three projects developed in the last few years. The GIS/TEK project maps traditional environmental knowledge in layers on a mapping software. Work has been done on the Five First Nations surrounding the Bras d'Or Lakes. This project represents a first step in discovering more about the environment in a more holistic way. Planned projects include a Bras d'Or Lakes biography which will be placed on the Internet. This will be a resource for those who are interested in scientific and traditional knowledge about the Bras d'Or Lakes. Further, the EFWC has been involved in the development of an ecosystems research project which will use stakeholder input to determine the direction scientific research will go into the Bras d'Or Lakes.

*GIS Project*

GIS (Geographic Information Systems) is a method by which information about the environment can be stored on maps. The maps can contain many different layers, including shellfish closures, recreational use, recent development and plant and soil types. This information could be placed on real hard copy layers in the past, but with the development of GIS computer mapping software, it is easier and more compact to store this information on virtual maps. The Eskasoni Fish and Wildlife Commission has been involved in resource mapping since 1995 when the coastal resources mapping project was developed. The goal of this program was to map the traditional knowledge of both native and non-native fishers, hunters and gatherers. This information was obtained through interviews and hand copied onto hard copy maps with mylar layers.

As we obtained the ability to use mapping software such as MapInfo, we applied to the North American Fund for Environmental Cooperation to do a project using this technology. Our first project was the mapping of traditional medicines from the Malagawaj reserve. The reason Mala was chosen was because it is a territory owned jointly by the five First Nations band in Cape Breton. The location of traditional medicines such as tupsi (alder), pa'kosi (cow parsnip), and others was mapped with the software onto 1:10 000 scale maps. The project team developed a method with which to interview the elders from Malagawaj, Eskasoni, Waycobah and Wagmatcook. This method generally involved sitting with the elders and drinking numerous cups of tea. The key was to listen to the elders as they told their stories as this is the way the information has traditionally been passed down.

The information was taken from the maps provided by the interviewer and was then mapped into the software using the mapping tablet. Other information obtained from the Department of Natural Resources, and the Municipal Land Development Services was also mapped thus showing the locations of roads, airports, mining activities, and soil type in relation to the plants that were mapped. The maps were placed in an atlas, which showed the traditional medicines of Malagawaj along with some historical facts.

Atlas (presented at workshop): The cover of the atlas shows a satellite image of Cape Breton. This symbolizes modern technology. Also, these are the images that the Mi'kmaq made into petroglyphs. This symbolizes the knowledge of the past combined with the technology of the present and future. Most recently, information for traditional medicines has been obtained for the other five first Nations Bands. This information has been combined with the information obtained from our Coastal Resources Mapping project. The result has been a new atlas of the five First Nations and Malagawaj, which shows the old and new information, combined. There is traditional medicines and plants along with animals that were used by First Nations. There are also mentioned areas of ecological importance such as herring spawning beds. This information technology is a tool with which we can learn to use our resources in a more sustainable way. We learn what the resources are and where they are. In this way, the traditional ecological knowledge of our people is preserved along with the resources. There is a great potential for the future use of this technology -- to document changes in the environment, to map changes in development, and hopefully in the future, to create time layers where information which may change over time can be placed in layers according to the years. For instance, traditional spawning beds for herring could be recorded one year as mentioned in anecdotal evidence. Additional layers could be used for recording the presence of spawning beds in different locations as conditions change from year to year. This gives us the ability to see more clearly the patterns of changes in animal and plants over time.

*BLINKs*

Scientific information concerning the Lakes has been developed by many different interest groups for many different purposes. It exists in many different places across Cape Breton Island and Nova Scotia. In order to bring this information together it was proposed that a web page called BLInKs be set up. BLInKs is the potential acronym for the Bras d'Or Lakes Internet Knowledge System. This is a system in development where information concerning the Bras d'Or lakes will be more accessible to people interested in it. Using the UCCB server, there will be a web page which will contain abstracts and bibliographies (and possibly contact names and emails) on the information surrounding the Bras d'Or Lakes.

In order to bring some order out of the chaos of scattered information, the Eskasoni Fish and Wildlife Commission, in conjunction with the Department of Fisheries and Oceans and other governmental and non-governmental organizations, are planning to set up a web page, which will contain information in various categories about the Lakes. Selecting one of the categories will bring up a bibliography of research documents pertaining to the Bras d'Or Lakes watershed. This information will include an abstract and a source for the information.

We would like to develop this web site further so that MapInfo information concerning the Lakes can be made available for viewing. We would also like to see a free information exchange service where information can be placed onto the website from researchers, hunters, fishers and other users. This would ensure that information concerning the Lakes will be more up to date and always accessible.

The role that the BLInKs project may play in the development of an ecosystem based fisheries resource management strategy is that of free information exchange. The BLInKs site will be a place where all the users of the resource will be able to assess the potential impact that their activities may have on the Lakes. All the research and scientific studies in the world are useless unless they are available to those who may need this information. As it is, information concerning the lakes is difficult to come by.

*Bras d'Or Lakes Ecosystems Research Project*

Over the past year, there has been an opportunity for the Eskasoni Fish and Wildlife Commission to use resources made available from the Department of Fisheries and Oceans. We now have use of the expertise of one of their scientists, Tim Lambert, and of the research vessel, the Navicula. This has inspired a small group of us to consider the question of how a research project, which will examine the whole ecosystems of the Lakes, be developed. In order to answer this question, we need to know what it is we already know, what we don't know, what we want to know, and how to obtain this information. In the past two years, Gadus Associates helped the EFWC answer the first question by developing a text which looks at all the knowledge about the Bras d'Or Lakes. This is currently in the publishing process.

Since we now know what we know, we need to consider the kinds of information that we don't know and their importance. The development of ecosystem management tells us that a lot of how organisms react with their environment and each other is unknown, and so, everything may be considered important. This brings us to how we priorize research so that the largest gaps in knowledge are filled first and so that those who live around the lake have a chance to assist us with these gaps. In order to do this, there will be an Ecosystems Research Conference from October 22-24, 1999. This gives the stakeholders who are interested a chance to direct research in the lakes. After the conference has been completed, a set of recommendations will be made which will assist in the development of a research plan for the Lakes. In this way, traditional viewpoints that may not have been considered in the past may be used to develop a research plan which combines traditional knowledge and scientific knowledge. This may improve our understanding of the way ecosystems work. This greater understanding will allow us to use our resources in more sustainable ways.

5.1.4. International Initiatives (Bob O'Boyle)

The inclusion of ecosystem considerations into ocean resource management is very complex and any lessons that can be learnt from other jurisdictions will greatly increase the chances of success of Canadian efforts. This talk is an overview of recent experience worldwide in the application of ecosystem principles to ocean resource management. It is based on presentations made at the March 1999 Montpellier ICES/SCOR Symposium[1] as well as discussions that I have had with Mike Sinclair. As well, it is an attempt to provide a comprehensive management structure into which ecosystem initiatives can be placed. From this perspective, the focus of the talk is on how one turns the theory into practice.

A management system can be considered to be composed of the processes of management (objective setting, definition of the targets needed to achieve the objectives, regulations to achieve the targets, and assessment and research) and the institutions of management (decision-makers and technical advisors). As ecosystem considerations can affect every part of the management system, it is important to consider international experience by each part.

*Objective Setting*

Given the complexity of ecosystems, getting the objectives stated correctly is very important but is an issue that few have so far addressed. For instance, in Montpellier, only some posters and presentations mentioned any objectives (e.g. Witherell and Pautzke). Most focused on other components of management system. This is in contrast to the April 1997 Forage Species Workshop, which stated that the following should be the objectives used to guide fisheries on lower trophic levels:

- minimization of risk of irreversible decline: maintain biomass of a species so it can realize its productive potential,
- maintenance of ecosystem integrity: maintain biomass of a species so that those species that depend on it can realize their full productive potential,
- maintenance of diversity of species, and
- control fisheries and maximize knowledge returns.

Thus the international experience is not much further ahead than we are.

[1] ICES/SCOR Symposium: Ecosystem Effects of Fishing, Montpellier, France, 15-19 March, 1999, Book of Abstracts, Organizers: International Council for the Exploration of the Sea (ICES), Scientific Committee on Oceanic Research (SCOR); Local Organizer: Institut de Recherche pour le Développement (IRD), 85pp.

*Strategic Targets*

A number of the presentations and talks in Montpellier made note of targets to guide the incorporation of ecosystem considerations into fisheries management. For instance, a variety of indicators were proposed for the Georges Bank ecosystem (Link). Many of these advised setting harvest targets according to the level of uncertainty (Witherell, Pautzke and Fluharty). Variability plays a big role in setting the harvest strategy of Antarctic krill by CCALMR (Commission for the Conservation of Antarctic Living Marine Resources). One author (Fowler - poster not at this workshop) recommended setting harvesting that allows observed levels of natural variation. This would require comparing the harvest rates to consumption rates of other species.

At the April 1997 Forage Species Workshop, targets based on the CCALMR approach for the above stated objectives were presented and took into account some of the variability of the system.

Notwithstanding this, some (Jones & Berry - poster not at this workshop) felt that the situation was too complex to predict. It was necessary to manage with no-take zones that allow self – regulation and provide reference areas (areas to compare to exploited areas and thus allow measurement of the impacts of harvesting).

It is evident that there is still lots to do on the strategies, particularly in relation to ecosystem structure.

*Regulations*

The Montpellier symposium received a number of submissions on this aspect of the management system. For instance, Witherell et al noted that in the US Northwest Pacific, TACs are set for all groundfish combined, which is lower than the sum of the individual TACs, similar to the old ICNAF two-tiered system. As well, the TACs are divided by area and season to provide forage for predators. There are also restrictions on the exploitation on forage species as well as by-catch regulations.

Spatial regulatory tools are used widely around the world for different reasons, some being:

- Marine reserves off Newfoundland (Guenette, Pitcher & Walters)
- No-take zones on Georges (Jones & Berry)
- Marine harvest refugia in Australia (Pollard)
- Shrimp closures in W. Gulf of Mexico (Castro-Melendez et al), and
- MPAs in Mediterranean (Francour), North Sea (Piet & Rijnsdorp) and NW Pacific (Wetherell et al)

The point is made that spatial regulations will not replace traditional tools and only supplement them.

Regarding gear regulations, papers on the ecological significance of bottom fishing (Steve Hall's review, and Gilkinson, Gordon & Kenchington posters) were presented in Montpellier and showed that the ecological response was related to gear and bottom type. However, there are many knowledge gaps and while there are impacts, the relationships are complex. The prudent approach is to identify sensitive areas and avoid them.

*Assessment and Research*

At the April 1997 Forage Species Workshop, it was emphasized that managers must be able to evaluate risk of not achieving management objectives. They must monitor the status of the impacted (targeted and bycatch) species as well as the so-called linked species, as is done by CCALMR.

Monitoring activities of note mentioned in Montpellier emphasized the spatial component of the ecosystem, be it the identification of significant or vulnerable habitat, variable fishing impacts by area, GIS applications (an emerging tool) and vessel/fishermen monitoring systems.

Worldwide, there is a need to integrate information across many disciplines and inclusion of the spatial component can facilitate this.

*Decision-making*

A number of the presentations and posters in Montpellier emphasized the need for effective decision-making processes when considering ecosystem approaches to management. The activities in the US Pacific Northwest (Witherell, Pautzke & Fluharty) were of note. Here, an ecosystem committee has been struck and reports on the state of the ecosystem on an annual basis. Similar activities are occurring off the coast of California (see Linen & Francis and pilot FEP).

Australia has also embarked on a system of regional marine planning with areas of coast defined for comprehensive coastal management purposes.

The presentation notes the need to define roles of everyone. This prevents confusion on who is responsible for what and provides a direct role of stakeholders in decision-making. Examples of this were given for India and Indonesia. The Developing Species Advisory Boards in Nova Scotia (Odette Murphy) and Community Management Boards in Nova Scotia (Lucia Fanning) are examples of more stakeholder participation in management plan development in Atlantic Canada.

*Technical Advisors*

Increasingly, research on our ecosystems is being either partially of wholly conducted by stakeholders. Examples given are:

- Southwest New Brunswick CMB (Maria Recchia)
- St. Georges Bay Ecosystem Project (Tony Davis & Nell den Heyer)
- Tek survey in Australia (Pascale Baelde)
- Pacific Whiting Conservation Cooperative (Vidar Wesperstad)
- Clam beds in coastal lagoon (Mazouni et al)

All these underline the need for stakeholder involvement in both research definition and prioritization.

*Summary*

Regarding strategies, there is a need to consider other parts of ecosystem than just fishing, which leads to the need to develop reference points (RPs) for a number of parameters (not just fishing mortality and biomass). RPs will be needed for ecosystem 'canaries' and forage species and will need to take uncertainty into account.

There is a need to build spatial models and use these as a means to link environment and biology.

Regarding the regulations, there is a need to define no-take zones but to consider the consequences of these outside of these zones. These areas should be used with other tools. The reference area and sensitive habitat concepts are useful to consider in our area. Regarding assessment and research, there is a need to define vulnerable habitat, monitor ecologically linked species, and develop large scale, multi-disciplinary, multi-agency, databases.

Regarding decision – makers, a transparent governance structure, which is both layered and involve stakeholders from all sectors, needs to be developed to facilitate ecosystem management.

Regarding information generation, it is necessary to set up mechanisms to involve stakeholders in the research definition and prioritization process. This is critical, given the complexity of the ecosystems.

Finally, when one steps back and views the needed changes to our management institutions, they fall into the following:

- Define unacceptable outcomes
- Take uncertainty into account
- Implement a decision process

This is nothing more than taking a precautionary approach to ocean resource management.

5.1.5. Adopting Other Models: "Governance and implementation in the case of scientific uncertainty: Are there lessons from the forestry sector?" (Jessie Davies).

This talk focused on governance and implementation. What can we do now in spite of our lack of scientific certainty? What concrete ways and means are available for incorporating ecosystem considerations into fisheries management?

These questions have been asked in many sectors, including manufacturing and forestry. Although the models in these sectors have been developed without full knowledge of the ecosystem linkages or the linkages with social and economic considerations, the best models have adopted an approach that is:

- Adaptive: while acting now, they include a mechanism for change (in the case of further scientific evidence) and for fine tuning the process as problems are identified through early implementation;

- Consistent with the precautionary principle: that a lack of clear scientific understanding cannot be used as a reason for inaction.

In forestry, the approach to forest management is based on three things:

1. the natural disturbance paradigm: understanding the impacts of fire, insects, and weather can help us to understand the structural dynamics of a forest and how to design interventions;
2. we can use our understanding of natural disturbances and the forest's ability to withstand them in order to set goals and objectives for the forest as habitat;
3. adaptive management: based on forecasting (wood supply habitat, ecosystem functioning); monitoring/tracking and redesigning interventions based on a comparison of monitoring results and forecasts (hypotheses).

The New Brunswick Crown Lands and Forests Act as a model, this act is analysed as an appropriate model for fisheries management. While the act has worked fairly well to predict wood supply, it is based on goals established by government without full stakeholder participation. This has led to a lack of clear biodiversity goals and an adequate representation of other values in forest management. The process of governance is split: the government sets the overall goals and the management plan design is the responsibility of industry. While this has resulted in an improvement in forest management on Crown Lands in the Province, it falls short of an adequate protection of ecosystem functioning.

Another possible model from forestry which might be adopted to fisheries management is certification. This process is intended to reward ecosystem protection (and other agreed upon values) by market access and market differential. Experience to date is slight, but tends to

show that companies are rewarded more by access to markets than by a price differential for sustainably managed forest products.

The success of each of these models is dependent on the objectives and goals set, the monitoring and the adaptation of changes where needed to meet existing goals (or to meet new ones).

## 5.2 Developing Recommendations: Summary of Working Group Reports

Following the presentations, the workshop chair led a discussion of the plenary group on the tasks to be assigned to the working groups (appendix 5). It was agreed that the following questions would be appropriate for the working groups:

- How should consultations be conducted to allow a nested (community to regional and national as appropriate) approach to fisheries management decision making regarding the ecosystem approach?

- What potential pilot projects could be undertaken?

- What communication activities do we need to take now on the ecosystem approach?

- What are the things that could make an ecosystem approach fail and what actions do we need to take to avoid these?

- Any other recommendations?

Below is provided the main conclusions of these discussions, with the principle recommendations for further action highlighted.

*Nested Approach to Decision Making*

While not being specific, the workshop highlighted a number of changes needed to institutions in the Maritimes Region.

1. To achieve ecosystem objectives in fisheries management, it was recommended that DFO build upon the existing Single Species Advisory Committees and institutional structures, in an incremental fashion.

An incremental approach was largely favoured over a revolutionary change to the multispecies and ecosystem committee and institutional structures. The existing groups need to be sensitized to ecosystem considerations. Each should review the discussions of this workshop and reflect on how to incorporate ecosystem approaches to fisheries management into their terms of reference. In addition, DFO needs to ensure that the committees have the required ecological expertise. Further, it was considered essential to adapt consultations and

participation to reflect the appropriate social/geographic/biological scale of decisions. A multi-layer approach should be taken that allows all stakeholders a means to participate in and contribute to decision-making. This will ensure that those affected by a decision have the most say in what the decision will be.

2. It was recommended that consideration be given to the establishment of overarching bodies or ecosystem boards, for specific ocean management areas, with single species committees feeding into the respective ecosystem board.

It is intended that these boards would oversee the activities of the single species committees. They should include all the appropriate stakeholder groups. An arbitration or conflict resolution system for both single species advisory committees and ecosystem boards also needs to be established. Many details remain to be determined. Therefore, the first step is for DFO to prepare Terms of Reference of these ecosystem boards for wide consideration and discussion. Establishment of these boards will be complex and potential groundfish management boards were identified as pilots (below).

*Potential pilot projects*

3. It was recommended that the ESSIM (offshore) and the Bras d'Or Lakes (inshore) pilot projects be continued and expanded to test the ocean management area concept.

ESSIM should immediately involve stakeholders (it is currently a DFO internal exercise) in its discussions. Efforts should be directed toward facilitating communications within and between these pilot projects. As a strong science base is essential for any pilot, all information sources should be utilized (DFO Science, TEK, university science, natural and social science). It was noted that RAP Stock Status Reports (SSRs) already include an ecosystem considerations section. This could be incorporated into Integrated Fisheries Management Plans (IFMPs).

It was noted that in future, TACs might no longer be determined in isolation of all other species within the ecosystem. Rather, single species RAPs would pool advice on status of resources, which would then be provided to an ecosystem RAP, where status and harvest impacts on all stocks would be viewed for the area in question. Such a RAP is already planned for the eastern Scotian Shelf in summer 2000.

It was noted that the 4X Herring Management Plan should be built upon from the perspective of ecosystem management. Also, the Bay of Fundy Fisheries Council project was identified as another potential pilot project. Some of the working groups felt that DFO may need to consider regulatory adjustments to allow pilot projects to proceed.

*Communication activities*

It was generally felt that mechanism needs to be developed to facilitate dialogue among the sectors (e.g. large corporate sector/offshore and local, inshore sector) as all stakeholder groups need to clearly communicate their objectives in terms of ecosystem considerations.

4. It was recommended that a communication pilot project be undertaken in conjunction with any pilot projects.

Any communication plan must consider how information gets from industry representatives to individuals. Wide dissemination is essential. A Website is a useful concept to consider, however, it must be recognized that this form of communication cannot reach all concerned stakeholders and ocean users. In addition, newsletters, mailings and the existing Communications Secretariat must be considered.

*Potential Failure Points and How to Avoid them*

The working groups identified a number of factors that will impede progress on ecosystem approaches and ways that these could be avoided.

- *Scale:* Decisions are often made or implemented at the wrong social, biological, or geographic scale: Local decisions must involve the grass roots.

- *Sectoral conflicts*: A conflict resolution process or system of arbitration needs to be established. Allocation issues must be removed from consideration for current users to cooperate in developing new approaches.

- *Fairness*: It is important that stakeholders feel that the process is fair. Clear and common goals, effective communications and involvement of all sectors are essential.

- *Workload:* Already industry members and bureaucrats are experiencing excessive workloads. This reality must be recognized and addressed. It is also important to recognize the different types of industry representation, ranging from professional, paid representatives to volunteer fishermen, and that there are different levels of capacity, commitment to the cause as a function of resources available.

- *Increased costs*: "Who pays" will have to be determined and negotiated. The importance of adequately funded science was stressed.

- *Consistency:* Decision-making must be consistent and be conducted within a structure and set of processes that are understood by all.

- *Jurisdictional issues*: There will be constraints to dealing with activities outside the DFO regulatory/legislative system (e.g. marine cables, oil & gas). The consultative structure may need to provide access to non-fisheries interests in the process.

- *Regulatory constraints*: An appropriate mechanism must be in place to allow ecosystem approaches to proceed. DFO has to be open to evolving and adapting.

*Other Recommendations*

There was consensus that the momentum from the workshop be maintained.

5. It was recommended that an Ecosystem Steering Committee be established to ensure follow-up on the workshop recommendations and act as a regional focus for progress towards an ecosystem approach to management.

The Planning Committee for this workshop would be a good interim group until a permanent committee is established.

6. It was recommended that, facilitated by the Ecosystem Steering Committee, definitions of new terms (such as biodiversity, and other terms causing difficulties in discussions in the course of this workshop) be developed.

It was agreed that there should be a regional follow-up on progress against the workshop's recommendations in one year's time. It was considered important that the Steering Committee keep track of progress in ecosystem approaches to fisheries management elsewhere (nationally, and internationally).

The results of the workshop will need to be considered by DFO to determine an action plan on its responsibilities. Stakeholder groups are encouraged to consider them as well to ensure that there can be progress towards the incorporation of ecosystem considerations into fisheries management.

## 6.0. CONCLUDING REMARKS

This workshop was the first of its kind in the Maritimes, if not Atlantic Canada. It brought together participation from government (federal and provincial), non-government, First Nations, and fishing interests to discuss the very complex task of the incorporation of ecosystem considerations into fisheries management. As stated at the beginning of this report, the objectives of the workshop were to develop concrete ways and means of incorporating ecosystem considerations into fisheries management and to foster communication and education of these concepts among all stakeholders. On both counts, the workshop was a success. Indeed, the degree of commonality and consensus among the working groups on the issues and how these could be resolved was remarkable. It is now up to all to ensure that the momentum of the workshop is not lost and to quickly move ahead on this important agenda.

## 7.0. ACKNOWLEDGEMENTS

In addition to all members of the Planning Committee, special thanks are also owed to a number of individuals who contributed to and helped make this workshop a success. Graphics support was provided by Francis Kelly and Art Cosgrove of the Technographics Division, Bedford Institute of Oceanagraphy. Carol Hope of DFO's Resource Management Branch, Gabriela Gruber, Science Branch, and Valerie Myra of the RAP Coordination Office provided all secretarial support. Diane Kenny, Shelley Van Tassel and Marie Parks of the Nova Scotia Department of Fisheries and Aquaculture provided invaluable assistance in support of workshop registration. Sharon MacKenzie and her staff at the NSAC Conference Center merit special thanks for their excellent service and versatile facility. Last but not least, thanks are extended to all working group chairs and rapporteurs, to those who contributed posters and reference material, and all workshop participants who took the time and effort to contribute to advancing this important theme.

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| Klaus Sonnenberg | Grand Mannan Fishermen's Assoc<br>Box 61, Grand Harbour<br>Grand Manan, NB<br>E0G 2M0 | 506-662-8481 | 506-662-8336 | |
| David Stanton | Clam Management Board, Digby/Annopolis<br>RR#2, Granville Ferry<br>Granville Ferry, NS<br>B0X 1K0 | 902-532-2109 | | |
| Dick Stewart | Atl Herring Fishermen's Marketing Co-op<br>Box 517<br>Yarmouth, NS<br>B5A 4B4 | 902-742-9101 | 902-742-1287 | |
| Tim Surette | DFO, Area Manger SWNS<br>215 Main Street<br>Yarmouth, NS<br>B5A 1C6 | 902-742-0871 | | SuretteT@mar.dfo-mpo.gc.ca |
| Greg Thompson | Fundy North Fishermen's Assoc.<br>Box 432 RR #2 Dipper Hbr<br>Lepreau, NB<br>E0G 2H0 | 506-659-2885 | 506-659-2191 | bsmall@symp.nb.ca |
| Deborah Tobin | East Coast Ecosystems<br>P.O. Box 36<br>Freeport, NS<br>B0V 1B0 | 902-839-2962 | 902-839-2335 | deb.tobin@ns.sympatico.ca |
| Glanville Travis | MFU Local 9<br>Box 112<br>Canning, NS<br>B0P 1H0 | 902-582-7395 | | |
| Dr. John Tremblay | DFO, Science<br>BIO, P.O. Box 1006 | 902-426-3986 | 902-426-7827 | TremblayJ@mar.dfo-mpo.gc.ca |

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| Evan Walters | Scotia-Fundy Inshore Fishermen's Assoc.<br>Box 158<br>Barrington, NS<br>B0W 1E0 | 902-637-3276 | 902-637-3270 | sfifa@klis.com |
| Martin Willison | Resource & Environmental Studies<br>Dalhousie University<br>Halifax, NS<br>B3H 4J1 | 902-494-2966 | 902-494-3728 | martin.willison@dal.ca |
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## Appendix 3. Workshop Program

Tuesday August 31

| | |
|---|---|
| 4:00 - 6:00 p.m. | On-site Registration and Poster Set Up |
| 6:00 - 7:00 p.m. | Cash Bar & Mixer |
| 7:00 - 9:30 p.m. | Banquet & Welcoming and Presentation of Workshop Objectives (Pat Chamut) |

Wednesday September 1

*Identification of Ecosystem Issues (Presentations in Plenary)*

| | |
|---|---|
| 8:15 - 8:30 a.m. | SWNB Industry Issues (Klaus Sonnenberg) |
| 8:30 - 8:45 a.m. | SWNS Industry Issues (Evan Walters) |
| 8:45 - 9:00 a.m. | ENS Industry Issues (Kelvin Hussey) |
| 9:00 - 9:15 a.m. | Offshore Sector Issues (Michael O`Connor) |
| 9:15 - 9:30 a.m. | NGO Issues (David Coon) |
| 9:30 - 9:45 a.m. | DFO Perspective on Ecosystem Issues (Mike Sinclair) |
| 9:45 - 10:00 a.m. | Ecosystem Management: International Perspective (Jake Rice) |
| 10:00 - 10:30 a.m. | BREAK |
| 10:30 - 12:00 a.m. | Open Discussion (Plenary) |
| 12:00 - 1:30 p.m. | LUNCH |

*Summary of Themes from issues presented*

| | |
|---|---|
| 1:30 - 1:45 p.m. | Plenary – instructions for break-out groups |
| 1:45 - 5:00 p.m. | Workshops: "How to address the themes?" |
| 6:00 - 7:00 p.m. | DINNER |
| 7:30 - 9:00 p.m. | Workshop reports (Plenary) |

Thursday September 2

***How do we make an ecosystem approach workable?*** *(Presentations in Plenary)*

| | |
|---|---|
| 8:30 - 9:00 a.m. | Eastern Scotian Shelf Initiative (Glen Herbert/Scott Coffen-Smout) |
| 9:00 - 9:30 a.m. | Bay of Fundy Council Fisheries Initiative (Maria Recchia) |
| 9:30 - 10:00 a.m. | Bras d'Or Lakes Project (Cheryl Bérubé) |
| 10:00 - 10:30 a.m. | BREAK |
| 10:30 - 11:00 a.m. | International Initiatives (Bob O'Boyle) |
| 11:00 - 11:30 a.m. | Adopting Other Models (Jessie Davies) |
| 11:30 - 12:30 p.m. | Workshops**: "**Developing recommendations" |
| 12:30 - 1:30 p.m. | LUNCH |
| 1:30 - 2:30 p.m. | Workshops - continued |
| 2:30 - 3:30 p.m. | Workshop reports (Plenary) |
| 3:30 - 4:00 p.m. | Wrap-Up: Recommendations & Conclusions (Plenary) |

## Appendix 4. How to address the issues: Working group reports

Below are provided the summary bullets/comments of the working groups, as reported by the rapporteurs on the first day.

Working Group 1: Tony Charles (Chair), Carol Ann Rose, Don Gordon, Ron Cronk, John Chardine, Denny Morrow, Brian Giroux, Bruce Adkins, Rick Young.

- Objectives and Reference Points needed for:
  - Ecosystem integrity
  - Bio/genetic diversity
  - Interspecies Impacts
  - Habitat
  - Ecological processes
- Develop common understanding of the terminology
- Clarify national policy and international obligations
- Recognize that there are intrinsic values outside of the commercial values
- Multispecies Adaptive management approach
- Reference points and performance measures (same as first bullet)
- Assess the quality of information be it pure science – TEK – opinion
- Mapping benthic habitat; mapping fishing effort on finest scale possible
- Continuously improving gear to reduce impacts
- Compatibility of different management units at varying spatial scales; need for ecosystem 'councils' based on ecosystem units
- Decision-making at lowest appropriate level – who's involved at each stage?
- Buy-in and participation of resource users and public at large critical
- How/ what triggers ecosystem assessment?
- Conflict resolution must be addressed
- We are already taking an ecological approach in some fisheries; we need to move further with better structures, the best information and industry buy-in
- Optimism

Working Group 2: Clarrie MacKinnon (Chair), Mike Murphy, Ken Rodman, Glyn Sharpe, Jake Rice, Marc Butler, Klaus Sonnenberg, Evan Walters, Jim Fraelic, Richard Nickerson.

*Objectives*

- Accelerate the move towards accomplishing ecosystem management
- Take incremental, cost effective steps
- Improve single species management that incorporates and identifies relationships with other species
- Need to incorporate interspecies relationships and indicators by species & nature
- Develop a report on health of all species within the ecosystem

- Measure how far we are willing to go to reach an ecosystem point of recovery or health
- Keep the need for biological info in ecosystem mgt simple & cost effective

*Strategies*

- Establish reference points and performance standards for more ecological aspects of the target species: e.g. age composition, spawning aggregations and other non-target species or components of ecosystem e.g. corals, eider ducks.
- Evaluation of where we are, our current status and how we got there
- Establish annual accounting systems to report on the impact of each fishery and other human activities on all species affected
- Develop a better integration of fisheries, habitat and coastal zone management
- Incorporate data/info from NGOs, First Nations, etc, into the accounting system

*Regulations or Tactics*

- Have well thought out, common sense, regulations.
- Review existing regulations and new ones to evaluate ecosystem impacts
- Educate and inform the public and the judicial system of costly consequences of crimes against the ecosystem & need for effective deterrents

*Monitoring & Research*

- This has been largely covered in Strategies
- Use of generations of knowledge sources

Working Group 3: Jessie Davies (Chair), Greg Peacock, Ted Potter, John Ritter, John Nielson, Alex Bielac, Nancy Shackell, Mick Burt, Kelvin Hussey, Don Cunningham, Sam Elsworth.

*Starting list of issues*

- Communication- Fishers/Management/Public
- Definition of Objectives Needed; Performance Measures-Who/How?
  - $ For Fishers
  - Biodiversity
  - Stock Components
- Need To Define Habitat By Species (Or Make The World Safe For Sea Lice)
- Biodiversity-related to what species
- Do It Right–local solution/adaptive mechanism
- Precautionary Approach-how does this relate to performance measures? Need mechanism to deal with the unknown, not everything is measurable, need flexibility
- Need Process To Define Specific Criteria
- What Is The Starting Point (of ecosystem state)? Today? Day 1?
- Who Decides?/How? Include multi-stakeholders, must determine allocation of resource, geographic area, across species

- Low Trophic Level (LTL): Species-How To Include In Process?

*The Answer*
- Using Canadian Herring Mgt Plan As Model, Use Series Of Single Species Management Plans
- Incorporate Ecological Approach
- Shortcomings Of Herring Mgt. Plan
- Establish Habitual Habitat Raps (annual?)
- Develop Mechanism For Dispute Settlement Mechanism Within Oceans Act
- Integrated Management Plans By Geographic Area

*Improving on the Herring Management Plan*
- Incorporate forage aspects (who eats who)
- Incorporate other trophic levels (whales, rockweed, grill etc)
- Ensure adequate scientific basis for decision making
- Incorporate mechanism to deal with other impacts: acid rain, climate change....also other activities (aquaculture. Municipal sewage)
- Develop mechanism to link with other species–(Integrated Management Plans by geographic area, Habitat RAPS)
- Consider: life history, by-catch, genetic variability

*Habitat RAPs*
- Hold on regular basis rather than being issue driven
- Need to develop performance indicators on habitat health
- Need to develop performance indicators with respect to biodiversity levels
- Need well defined remit:
  - ecological monitoring process
  - measure of change over time
  - definition of criteria and indicators (seabirds)
  - marine quality guidelines
  - assess impacts
  - EMAN-monitoring protocols/testing of protocols
  - Role for community (ACAP, estuary)

*Conflict Resolution*
- CCALMR process for assessing krill fishery in the Arctic may be appropriate model
- Need (cables, oil and gas industry, municipal discharges..)
- Incorporate within Oceans Act
- Linkage with single species plans is geographically based Integrated Management Plan
- Incorporate Compensation Plan

Working Group 4: Dave Bollivar (Chair), Evelyne Meltzer, Bob O'Boyle, Ed Trippel, Anthony Diamond, Patricia King, Jean-Guy d'Entremont, Greg Thompson, Barry Jones, Dave Duggan.

The subcommittee went around the table and searched each member's meaning of ecosystem management and ecosystems approach.

- The term "Ecosystem approach" to fisheries management should be used rather than "Ecosystem management"
- For every action there is a reaction.
- We can only manage human activity in the marine environment , eg. fisheries, oil/gas , ecotourism activity , pollution , etc...
- We can influence ecosystem however we cannot control ecosystems.
- We lack a collection of data to monitor the marine ecosystem.
- Many players ; users (fishers, oil/gas , transportation , ecotourism , recreation , and the general public . If ecosystems approach are to work properly, one must use all their different knowledge in decision making -When harvest levels are set , there must be a portion of the stock set aside for predator / prey .

*Objectives*
- To try to maintain viable populations within the ecosystem to maintain biodiversity and critical habitat.
- There is a need to balance ecosystem considerations and human activity.

*Strategies*
- A stakeholder education program
- Environmental impact assessments
- Socio-economic impact assessments
- Co-operation from all sources of science (inter-governmental, universities, etc)
- There is a need to focus on a broad range of indicators including those that cannot be quantified. (Red light , Green light , Amber light )

*Regulations or Tactics*
- First you assess what is working and what is not.
- Fix what is broken and move people / money to improve.
- Involve stakeholders and Regulators to promote compliance.

*Monitoring and Research*
- Need to use external information. eg. polar ice cap info , trans-boundary resources , climate consideration
- Need to design an integrated monitoring system involving all stakeholders
- Make better use of information that already exists -data exchange protocol.
- Make ecosystems research tax deductible to private enterprise.

*Decision-making*

- The subcommittee believes that the decision - making process is paramount for the ecosystem approach to be sold to the stakeholders and to its success.
- Investigate what boards, groups , councils , government bodies , institutional arrangements , are active and study their roles in responsibilities concerning the ecosystem approach .

Working Group 5: Marianne Janowizc (Chair), Faith Scattolon, Jim Jamieson, Kees Zwanenberg, Corey Francis, David Coon, Martin Willison, Nell den Heyer, George Rose, Michael O'Connor, Gary Deddrick, Glanville Travis.

The group struggled over defining an ecosystem. To what extent does it deal with geographic boundaries and what scale, and does it apply to fisheries only? After some discussion, it was agreed to move on. Consensus was reached on the following:

*Objectives*

- On the broadest level, we should manage, restore and enhance ocean environment so as not to deny future generations the opportunities and resources that we enjoy today.
- Our next objective is to maintain and where necessary restore or enhance, the ecological integrity of oceans at multiple scales so that essential ecosystem processes are not compromised, biological diversity is retained and a productive system is maintained for utilitarian purposes. Concern about the downtrend implications of this objective on fishing activity.
- There needs to be a balancing of ecosystem considerations and human activities. The principle of compensation for lost activities was considered a reasonable response. There needs to be fairness and equity relative to socio-economic impacts of ecosystem based fisheries management.
- Any objectives should not be applied exclusively to the fishing industry but other users as well. We'll need a buy-in from ocean users to successfully save ecosystems

*Strategies*

The following strategies were considered essential:

- An adaptive management approach
- Precautionary approach
- Agreed to replace operational targets to guide ecosystem management with the development of useful ecosystem metrics
- Need for reference points and performance measures for biodiversity and habitat productivity
- Linkage of climate and other ocean sciences with fishing activities
- The consideration of land and sea interactions
- Education awareness; users of the ocean need to be self aware of the impacts of their activities on the marine environment. There was recognition that this will take time and

be evolutionary. The Code of Conduct for Responsible Fishing may be an appropriate channel

*Regulations or Tactics*

- We can't fully attain compliance now on single species basis. We need to assess what our abilities are to promote compliance and in an ecosystem context, we need voluntary compliance in the short term

*Monitoring and Research*

- Need more long term ecological research
- Need to develop ecological reference points
- Need to identify key ecological areas
- Need to identify key ecological underpinnings of commercial species
- Need to link all ocean sciences
- Need to conduct ecological economic research such as full cost accounting
- Need to determine how to monitor an ecosystem
- Need to use all sources of knowledge
- Need to monitor non-fishing impacts

*Decision-making*

- We need a process to bring ocean users together to deal with ecosystem users with consensus, resolution and decision-making as a goal. There needs to be accountability for decision-making.

*Information Gathering*

- We agreed funding is a major challenge. Cooperative approaches and priorities are essential. One example where cooperation is possible is outside 12 miles.
- There should be a tax credit for industry sponsored R & D.

Working Group 6: Graham Daborn (Chair), Mike Sinclair, Bob Rutherford, Jon Hansen, John Tremblay, Chris Milley, Inka Milewski, Eric Roe, Don Aldous, Brian Guptill.

Began by attempting to identify consensus on Objectives provided in chairman's outline. After much debate, abandoned discussion of Objectives and attempted to redirect approach by addressing the question:"To what degree do present Conservation Objectives of Fisheries Management Plans need to be changed to incorporate ecosystem considerations?" Using existing (single species) management plans:

- incorporate "other species" criteria in newly developed single species management plan;
- enhance role of local input
- revise existing plans to incorporate ecosystem considerations; present revision to stakeholders & revise again

Then discussion returned to original charge.

*Objectives*

- Seen as +/- equivalent to "Principles"?
- Biodiversity & Habitat productivity – no dissent
- Balancing ecosystem and human consideratons – no consensus
- Noted need to include balance between fisheries and other potential or real uses of the ecosystem
- Sustainability - no dissent
- Valuing other ecosystem components – no dissent

*Strategies*

- Incremental & adaptive management – no dissent
- Precautionary Approach - 1 dissenter (preferred application of P.P.)
- Develop operational targets – no dissent
- Develop reference points & performance measures related to *Biodiversity* and *Habitat Productivity* objectives – no dissent
- Issue: need to incorporate Restoration activities, not just manage present status (An Objective, or a Strategy?)

*Regulations or Tactics*

- Review and *integrate* existing management plans / activities / regulations in light of ecosystem objectives – no dissent (Use a multistakeholder method)
- Promote compliance by enhancing "buy in" through assignment of rights, responsibilities and accountabilities – no dissent

*Monitoring & Research*

- More ecological research using all sources of knowledge – no dissent
- Develop syntheses of our coastal ecosystems, prepare interpretive maps & models (etc) for enhancing awareness – no dissent
- Disseminate information widely and ensure access to data by stakeholders – no dissent
- Industry is an important/essential contributor to monitoring and research - both in data acquisition and financing.
- Current license fees should be redirected in support of monitoring & research (no vote). NB An important issue: Proprietary restrictions by participants in Research & Monitoring that limit access to data

Working Group 7: Diane Kenny (Chair), Tim Surette, Odette Murphy, Les Burke, Claude d'Entremont, Hubert Saulnier, Dan Lane, Marcel Comeau, Ginette Robert, John Kearney.

*General Comments*

- The fishing industry needs to "reinvent" itself: it must be "greener" and acknowledge the need to accommodate and recognize impacts of others.

*Objectives*

- Industry viability must be considered.
- Allocation must be removed from consideration for current users to cooperate in developing new approaches.
- Mike Sinclair's approach to objectives, performance measures, and reference points was generally endorsed as an operational approach. There were reservations: nature's wide swings cannot be dampened by man's response (even a ban on fishing may not allow recovery).
- There was much debate over what biodiversity means.

*Strategies*

- Adaptive management was supported (don't discard what works).
- Need to expand and diversify what we do now (as per Mike Sinclair's presentation) to include operational targets and reference points for other parts of the system.

*Regulations or Tactics*

- Need to advertise what industry are now doing. This should be part of a strategy to "green" industry
- Support for moving forward in a pragmatic way.

*Monitoring and Reporting*

- Developing a system to value ecosystem components was not seen as an item under this heading. It is reflected through stakeholders during objective setting.
- Need to monitor "fishing impacts" as well (on habitat and incidental mortality).

*Decision-Making*

- The governance structure must extend to the setting of objectives
- Need for local area based structure to work from the bottom up, involving stakeholders at that level, working within a top down framework extending from the International, National, and Regional level.
- Framework, principles, approaches, guidelines, strategic direction, legislation, characterize the top down products.
- Species plans, operational plans, land use plans, etc… characterize the local products, nested within the framework.
- Agreement on outcomes is important.
- Need to prevent gridlock in consultations and decision-making

- Allocation question and poorly defined security of fishing rights and access greatly complicates the process.

## Appendix 5. Developing recommendations: Working group reports

Below are the talking points of the working groups as presented on day two.

Working Group 1: Tony Charles (Chair), Carol Ann Rose, Don Gordon, Ron Cronk, John Chardine, Denny Morrow, Brian Giroux, Bruce Adkins, Rick Young, Maria Recchia, Tim Surette.

*Nested approach*

- Keep the ball rolling at a number of levels
- Steering Committee needs to get definitions out
- What is happening in the other regions and nationally – needs to be considered
- Follow up in a year's time in what we have discussed but it has to feed into national process

*Pilots*

- Bras d'Or
- ESSIM
- More than enough right now
- Review body to assess pilots and keep ball rolling/ don't leave just to DFO

*Failure points*

- Lack of communication and not involving grass roots
- Not an allocation discussion
- Don't use ecosystem management
- DFO not open to evolving and adapting
- DFO has to be the spokesperson for the ocean
- Social fairness – would cause failure if not addressed; 1) current generation should be involved 2) intergenerational & stewardship and 3) if costs now, must be spread
- Utilize all information sources

Working Group 2: Clarrie MacKinnon (Chair), Mike Murphy, Ken Rodman, Glyn Sharpe, Jake Rice, Marc Butler, Evan Walters, Cheryl Bérubé, Odette Murphy.

*Nested approach*

- Consultation with user groups (consider funding/timing/preparation)
- Need to adapt the consultation and participants to reflect the appropriate scale
- (geographic & biological) of the decisions
- Current institutions have to be made aware and sensitized to ecosystem approaches
- Should lines & boundaries (fisheries management units) be revised to reflect ecosystems?; through OMA RAP
- Incremental approach vs change to multi-species and ecosystem approach

- Top down vs bottom up; OMAs address user group Conservation Harvesting Plans (CHPs) – top down
- OMA RAPs; single species RAP pool advice on status of components; advice framed at OMA level; feedback down to single species

*Pilots*

- Key species indicators; report all catches in logs; Potential pilots – implement logbooks for key species in specific Fisheries; collect all species data
- Look at non-target species for ecosystem effects
- CHPs & IFMPs must contain ecosystem considerations
- RAPs to feed into OMA RAP
- Collect & identify all species in research surveys
- Train & educate volunteers to provide ecosystem information in sensitive areas
- Websites, FSRS, FAO expert system adapted

*Failures*

- Decisions made or implemented at wrong social, biological or geographical scale
- If there are no changes, then we will have failed
- Absence of conflict resolution process

Working Group 3: Ted Potter (Chair), Jessie Davies, John Ritter, John Nielson, Nancy Shackell, Mick Burt, Kelvin Hussey, Don Cunningham, Sam Elsworth, Les Burke, Hubert Saulnier, Dan Lane.

*Nested Approach*

- Maintain the single species advisory committees; build on them to ensure they have the required ecological expertise
- Establish Ecosystem Boards with the individual species board members feeding into the respective Ecosystem Boards
- Conflicts not resolved in the individual species boards can be resolved jointly with the appropriate single species board or if a local issue, through respective local Ecosystem Boards
- Establish an arbitration system for both the single species boards and the Ecosystem Boards

*Failures*

- Increased workload (for industry members, bureaucrats)
- Increased costs (who pays?)
- Require a system of arbitration (in place of potential intervention)
- Lack of consistency in operations and decision-making criteria across boards (species or ecosystem)
- Difference of opinion on access rights, while others think it should be more flexible

- Gear conflict is and will continue to be a problem unless based on ecological considerations
- Structure does not provide access to non-fisheries interests into the process (e.g. oil & gas)
- Constraints to dealing with activities outside the DFO regulatory system (e.g. marine cables, oil & gas)

*Recommendation*

- Priority be given to investigating what others (other parts of the world) involved in this approach are doing with respect to the problems/constraints identified above.

Working Group 4: Dave Bollivar (Chair), Evelyne Meltzer, Bob O'Boyle, Ed Trippel, Anthony Diamond, Patricia King, Jean-Guy d'Entremont, Greg Thompson, Barry Jones, Dave Duggan, Marcel Comeau.

*Nested approach*

- Didn't like the word "consultation" – stakeholders should have more than this
- Build on existing species advisory committees but all groups should take into account ecosystem considerations
- SSRs should immediately include an ecosystem considerations section; this could/would lead to incorporation of these into IFMPs
- Assess structures that exist now and determine what is working
- Develop a broader approach based on what is working; stakeholders in decisions
- Accountable only to minister; veto power like NMFS/councils; would force regional accountability
- Pay careful attention to whom are the stakeholders; need hierarchy of these as need to ensure that those who are affected have the most say

*Pilots*

- Build on ESSIM; immediately involve stakeholders; full fledged project
- Establish stakeholder group
- Include Fishermen and Scientists Research Society
- Area characterized by a troubled ecosystem
- Devote effort to facilitating communications: valuable to see what happens
- Need a good communications program
- Code of conduct developed by industry

*Failures*

- If we do not have effective communications
- If we try to move too fast
- There needs to be a continuation of a group of this meeting – the steering committee

Working Group 5: Marianne Janowicz (Chair), Faith Scattolon, Jim Jamieson, Kees Zwanenberg, Corey Francis, David Coon, Martin Willison, Nell den Heyer, George Rose, Michael O'Connor, Gary Deddrick, Glanville Travis.

*Nested approaches*

- Need to design a system for local level decision making but within a structure and with a set of processes which are understood
- Structure needs to be sufficient that everyone can buy into it
- Needs conflict resolution mechanism; Democratic and conflict resolution
- Needs to be inclusive
- Need local decision making as existing vehicles not there
- Need for multi-species group; need Terms of Reference for this

*Pilots*

- Groundfish management boards (also lobster) are models or 'pilots'
- Fundy Fisheries Council: Its objectives need better communication
- Communication pilot?
- Eastern Scotian Shelf Project (DFO – OACO)
- DFO should endorse some projects e.g. provide permission to do some things as experiments e.g. FFC get variances on specific regulations to try something out; results should be communicated; Support from DFO especially when time/area changes in fishing and if regulatory change; Particularly interested in Upper Bay as it may need regulatory adjustment
- Any pilots need strong science base; DFO Science, TEK and university science, natural and social science

*Communications*

- Lack of mechanism for input between sectors (e.g. large corporate sector and local associations)
- For ecosystem approach, need clear communication of objectives of all stakeholder groups
- Website concept useful but can't reach all; (Communications Secretariat a useful regional communication tool as well)
- Newsletters
- Mail to individual members of associations
- Need communication pilot?

*Failures*

- Gear conflicts; sectoral conflicts; community conflicts over allocations; need clear objectives to resolve gear conflicts
- Use regional approach and include all sectors
- Need clear objectives – all on the table

- Given importance of communication, a structure and support system that is appropriate is needed
- Everyone must feel that the process is fair
- Clear common goal
- Regulations – need to find appropriate mechanisms to allow ecosystem approach to go forward

*Other issues*
- Recognize that there are different types of representation, as well as sectors, gears, regions, etc..e.g. professional representatives and fishermen as representatives
- Rubber hits the road over regulations; need to find mechanisms to permit appropriate experiments or pilots
- Importance of science: how to change it to be more ecosystem based; Science need money
- Martin Willison's 's diagram on communication between pilots

Working Group 6: Graham Daborn (Chair), Mike Sinclair, Bob Rutherford, Jon Hansen, John Tremblay, Chris Milley, Inka Milewski, Eric Roe, Don Aldous, Brian Guptill, Claude d'Entremont, Diane Kenny.

*Nested Approach*
- Bottom up but with some lead
- Build up existing structures – species advisory committees
- Ask advisory committees to reflect on how to incorporate ecosystem considerations
- Need overarching body over species advisory committees; need code of civility
- Discuss with sectors that gear and allocation issues are not to be the point of discussion
- Consider terms of reference of species advisory committees?
- Need to think out how it would all fit together

*Pilots*
- ESSIM (offshore) and Bras d'Or Lakes (inshore)
- Already on the way
- Focus on these

*Communications*
- At upcoming species advisory committees, discuss this workshop
- Website to continue discussion
- Need communication plan; how does info get from representatives to individuals?

**Appendix 6. Posters and abstracts.**

Below are abstracts of selected posters from the ICES/SCOR Symposium on "Ecosystem Effects of Fishing", Montpellier, France, March 1999, reprinted for the DFO Ecosystem Approaches to Fisheries Management Workshop, with permission from the authors:

Impacts of Otter Trawling on Infaunal Bivalves Living in Sandy Bottom Habitats on the Grand Banks of Newfoundland. K.D. Gilkinson[1], P. Schwinghamer[1], D.C. Gordon Jr.[2], J. Prena[2], T.W. Rowell[2], D.L. McKeown[2], W.P. Vass[2], K. McIsaac[2], C. Bourbonnais[2], M. Paulin[3] and S. Hurley[3]

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Approximately 75-85% of bivalve faunas of continental shelves are comprised of infaunal species. Their importance can be measured in terms of their role in benthic-pelagic nutrient exchange, as prey, for creation of habitat structural complexity and enhancement of exchange processes at depth. Large areas of the Grand Banks consist of sand over which otter trawling has been conducted since the 1950s to harvest groundfish. Although there is no otter trawl fishery on the Grand Banks that targets bivalves, a significant proportion of infaunal species reside in the uppermost several centimeters of the sediment. This falls within the direct scouring zone of trawl gear. A series of field and laboratory experiments were conducted in order to investigate the impacts of otter trawling on bivalve populations living in sandy sediments on the Grand Banks.

Invertebrate bycatch was quantified from two types of otter trawl during routine Fisheries and Oceans groundfish surveys conducted on the Grand Banks. Capture rates were very low, averaging one bivalve per 30 minute tow. Capture efficiency, calculated as the ratio of bivalves captured to those swept over by the gear, was on the order of $10^{-5}$.

In order to investigate non-capture related impacts, a three-year otter trawling experiment was conducted on a sandy bottom ecosystem (120-146 m) on the northeastern Grand Bank of Newfoundland. Each year, three 13 km long corridors were trawled twelve times with an Engel 145 otter trawl, equipped with rockhopper footgear. Sampling of bivalves was conducted each year before and after trawling in experimental corridors and adjacent reference corridors using a hydraulically-operated 0.5 $m^2$ video grab. Intense annual trawling had no detectable effect on densities or biomass of bivalves. Recruitment rates were similar between experimental and reference areas. Three years of trawling had no effect on population size structures.

An unexpected result was the high frequency (90 ± 4 %) of non-damaged shallow burrowing bivalves sampled immediately after trawling. Otter boards used on the Grand Banks are massive (>>1000 kg each). They exert the greatest force per unit area of any gear component and are generally regarded as the most destructive aspect of the gear. In order to investigate the physical processes of trawl door scouring and damage to bivalves, a full-scale trawl door model was fabricated and tested in an instrumented sand testbed constructed to simulate key geotechnical properties of a natural seabed. Within this testbed, preserved specimens of infaunal bivalves were planted at species-specific depths in order to record patterns of displacement and damage. Results of this experiment partially explain the field trawling results. Out of a total of 42 specimens placed in the immediate scouring zone of the model (upper 2 cm of sediment) only 2 were damaged although the majority were displaced. A model based on sediment mechanics, scouring depth and size of bivalves is proposed to explain this paradox. In advance of the trawl door shoe, sediment is excavated to the surface and cast aside from the trailing edge to form a low rounded berm. Small and medium size (<4 cm) near-surface bivalves are excavated to the surface and entrained within this fluid medium, effectively being buffered from direct contact with the shoe. These individuals become concentrated and exposed along the berm. Large, near-surface bivalves extend below the critical depth for excavation and are destroyed through direct contact with the shoe.

Independent lines of evidence suggest negligible impacts from otter trawling to populations of infaunal bivalves. These results apply to populations dominated by small and medium sizes living on level sandy seabeds. However, due to the low statistical power associated with the field data, temporal scales and our limited understanding of marine ecosystems, some important impacts may have gone undetected. Therefore, a precautionary approach is warranted.

Banquereau Hydraulic Clam Dredging Experiment. K.D. Gilkinson[1], E. Kenchington[2], D.C. Gordon Jr.[2], K. MacIsaac[2], C. Bourbonnais[2] , D. Roddick [2], S. Naidu[1], D.L. McKeown[2], W.P. Vass[2] ,G.B.Fader[3] and M. Lamplugh[2]

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A three-year experiment to study the effects of hydraulic clam dredging on the benthic habitat, benthic community and offshore surf clam (*Mactromeris polynyma*) population of a sandy seabed on Banquereau (about 75 m depth), a fishing bank on the Scotian Shelf, was initiated in May 1998. This experiment was designed and is being conducted in close collaboration with the offshore clamming industry. The chosen site has not been subjected to clam harvesting, has relatively uniform environmental properties throughout the 1.5 x 2

km experimental frame, and has a well-developed benthic community. It has been closed to commercial clamming for the duration of the experiment. The experimental design includes three different treatment boxes: dredged only (X), discard only (Z)(discard from X), and dredged and discard combined (Y). Two reference boxes are also located in the experimental frame. Experimental dredging was done by a commercial clamming vessel equipped with two, 4-m wide hydraulic clam dredges. The two dredged boxes are 500 m long and each was dredged twelve times such that the disturbed area was about 150 m wide. Subsamples of the catch, which was processed following usual industry procedures, were collected to determine the species composition, abundance and biomass of the bycatch. Benthic surveying and sampling was done before and after dredging in both the treatment and reference boxes. Data collection included sidescan sonar, QTC sediment classification, continuous benthic video surveys using BRUTIV, benthic video and still photographs taken with Campod at specific stations, and benthic samples collected with a hydraulically-operated 0.5 $m^2$ videograb. DRUMS$^{TM}$ was fitted on the videograb to obtain acoustic information on changes to sediment habitat structure. In July 1998, a multibeam bathymetric survey was made of the study site. No repeat dredging is planned but the site will be resampled in May 1999 and 2000 to study recovery from the initial disturbance. Some preliminary results of this three-year experiment in progress will be presented.

Western Bank Otter Trawling Experiment. E. Kenchington[1], K.D. Gilkinson[2], D.C. Gordon Jr.[1], K. MacIsaac[1], C. Bourbonnais[1], D.L. McKeown[1], W.P. Vass[1], G.B. Fader[3] and M. Lamplugh[1]

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A three-year experiment to study the effects of otter trawling on the benthic habitat and community of a gravel seabed was initiated on Western Bank (about 70 m depth) in October 1997. The experimental site (2 x 2 km) is within the 4TVW haddock nursery area on the Scotian Shelf which has been closed to mobile fishing gear (except scalloping) since 1987. Experimental trawling was conducted along a 2 km corridor using the same Engel 145 rockhopper otter trawl that was used in the Grand Banks experiment (1993-95). Twelve trawl sets were made back and forth along the same line. Trawl catch was processed to determine species composition, abundance and biomass of fish and invertebrate species. Fish stomachs were collected to determine major prey species. Benthic surveying and sampling was done before and after otter trawling along the experimental corridor and three neighbouring reference corridors. Data collection included sidescan sonar, QTC sediment classification, continuous benthic video surveys using BRUTIV, benthic video and still photographs taken at specific stations using Campod, and benthic samples collected with a hydraulically-operated 0.5 $m^2$ videograb. This field program was repeated in May 1998.

The experimental corridor was retrawled and observations were made along the same transects and at the same stations before and after trawling. The only change in procedures was that DRUMS™ was fitted on the videograb to obtain acoustic information on possible changes to sediment habitat structure due to trawling. In June 1998, a multibeam bathymetric survey was made of the study site. The field program, including retrawling, will be repeated a third time in May 1999. Some preliminary results of this three year experiment in progress will be presented.

Grand Banks Otter Trawling Experiment. D.C. Gordon Jr.[1], K.D. Gilkinson[2], E. Kenchington[1], J. Prena[1], P. Schwinghamer[2], T.W. Rowell[1], D.L. McKeown[1] , W.P. Vass[1], K. MacIsaac[1], C. Bourbonnais[1] , J.Y. Guigné[3] and G. Sonnichsen[4]

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A three year experiment (1993-1995) on the effects of otter trawling on benthic habitat and communities was conducted on a sandy bottom ecosystem (120-146 m) on the Grand Banks of Newfoundland. Each year, three 13 km corridors were trawled twelve times with an Engel 145 otter trawl, equipped with rockhopper footgear, creating a disturbance zone 120-250 m wide. Benthic surveying/sampling, done before and after trawling in experimental corridors and nearby reference corridors, included sidescan sonar, RoxAnn™, BRUTIV (mounted with video), epibenthic sled (video-equipped), and a newly designed hydraulically-operated video grab fitted with DRUMS™.

Trawling had no apparent effect on sediment grain size. There was a significant increase in the RoxAnn™ E2 signal during trawling suggesting changes in seabed topography. Door tracks were readily visible on sidescan sonar records immediately after trawling, ten weeks later and in some cases still faintly visible after one year. Video observations revealed that the seafloor of the trawled corridors was lighter in colour than reference corridors, and that organisms and shell hash tended to be organized into linear features parallel to the direction of trawling. Untrawled seabed had a hummocky, mottled appearance with abundant organic detritus while recently trawled seabed was generally smoother and cleaner. Door tracks and damaged organisms were also visible on occasion. DRUMS™ data indicated that trawling caused significant changes in small scale subsurface sediment structure down to depths of 4.5 cm. It appears that seabed habitat recovered from the trawling disturbance in about one year.

The total biomass of invertebrate bycatch in the trawl decreased significantly over the twelve trawl sets. An influx of scavenging snow crabs (*Chionoecetes opilio*) into the trawled corridors was observed after the first 6 sets (approximately 10-12 h). The biomass of benthic organisms as sampled with the epibenthic sled was on average 24% lower in trawled corridors than in reference corridors. At the species level, this biomass reduction was significant for snow crabs (*C. opilio*), sand dollars (*Echinarachnius parma*), brittle stars (*Ophiura sarsi*), sea urchins (*Strongylocentrotus pallidus*) and soft corals (*Gersemia* sp.). The reduced biomass of epibenthic organisms in trawled corridors is due to several interacting factors including direct removal by the trawl, mortality, damage, predation and migration. The homogeneity of the macro-invertebrate community collected by epibenthic sled was lower in trawled corridors. Sand dollars, brittle stars and sea urchins demonstrated significant levels of damage from trawling. The mean individual biomass of epibenthic organisms was lower in trawled corridors suggesting size specific impacts of trawling, especially for sand dollars. No significant effect of trawling was observed in the four dominant mollusc species captured by the sled (*Astarte borealis, Margarites sordidus, Clinocardium ciliatum* and *Cyclocardia novangliae*).

A total of 251 invertebrate taxa were identified in the 200 videograb (0.5 $m^2$) samples collected and processed in this experiment. Biomass (954-1144 g $m^{-2}$) was dominated by two species: *Cyrtodaria siliqua* (propeller clam) and *Echinarachnius parma* (sand dollar) which together account for 65% of the total. Twenty-seven species were found in more than 90 % of the samples and accounted for 89% of the total biomass and 87% of the numerical abundance. The total mean benthic biomass in experimental corridors was consistently lower immediately after each trawling episode and experimental corridors consistently had lower mean biomass than reference corridors on all sampling dates, but these decreases were not significantly significant because of considerable variability. At the species or lowest identification level, no statistically significant trawling effects on biomass could be seen in molluscs, however some small near-surface dwelling polychaetes and the sand dollar (*Echinarachnius parma)* were negatively impacted. Observed trawling effects seem to be limited to taxa living close to the sediment surface. Ten polychaetes showed a significant decrease in biomass between 1993 and 1994 in the reference corridors. This observation is consistent with observed changes in the sediments occurring during this time period. Otherwise, the biomass distribution of these individual taxa was relatively homogeneous in the reference samples over time and space. The mean densities of 133 taxa representing species with a frequency of occurrence greater than 10% were examined graphically. Five patterns were observed with the most predominant response (50.5%) being a negative impact on density immediately after trawling. However, 35.5% of these species, notably polychaetes, crustaceans, gastropods and echinoderms, responded with an increase in density, and 14% of these taxa showed no response to trawling. Gastropods were the only group where an increase in density was more common than a decrease.

The effects of mobile fishing gear on benthic habitat and communities depend upon numerous factors including the the type of gear, the intensity of use, the kind of seabed and the organisms present. This experiment indicates that repetitive otter trawling on a sandy

bottom can produce detectable effects in both habitat and communities. Surficial sediment properties appear to recover in about one year but effects on selected benthic organisms may be longer lasting.

The effects of fishing on demersal fish communities of the Scotian Shelf (Canada). K. Zwanenburg

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This work describes the recent history of exploitation and the apparent biological responses of demersal fishes for two adjacent north temperate marine shelf systems, the eastern and western Scotian Shelf. Annual landings of demersal fishes (mainly gadids) on the eastern shelf have ranged from as high as 450,000 t in the 1970's to about 30,000 t in 1993. On the western shelf, landings went from more than 100,000 t in the early 1980's about 40,000 t recently. Estimates of fishing effort increased rapidly between 1977 and 1992 with effort on the western shelf at approximately 3 times that of the eastern shelf by 1992. In 1993, historically low levels of cod (*Gadus morhua*) biomass led to the imposition of a cod fishery closure on the eastern shelf. Low stock estimates have also prompted restrictions on total allowable removals on the western shelf which have curtailed effort since 1993.

Indices of exploitation (landed biomass / minimum trawlable target biomass) for the eastern and western shelf reflect major events in the exploitation history for these areas. Exploitation was relatively high during the early 1970's with the presence of a large number of foreign vessels on the shelf (especially the eastern shelf), and declined significantly following the establishment of Canada's 200 exclusive economic zone and the exclusion of these foreign vessels. From 1977 to 1993 exploitation increased steadily reflecting the increased domestic effort on the shelf, and declined significantly following the moratorium on most fishing imposed in 1993.

Trawlable biomass for the eastern shelf shows a marked decline from the mid 1980's to the mid 1990's while trawlable biomass on the western shelf shows a much more gradual decline from the mid 1980's to the present. Trawlable biomass on both halves of the shelf is presently at or near the lowest in the time series. For the eastern shelf, cod has declined from an average of 29% of biomass to about 10% of biomass. In both systems, declines in biomass are most significant for commercially targeted species while only a few non-target species show consistent declines.

The average weight of a fish on the eastern shelf declined from about 1.4 kg in the early 1970's to 0.47 kg in the late 1990's, a decrease of 66%. On the western shelf, this average fell from 1.9 to 0.74 kg, a decrease of 61% over the same period . Average weight of all fish was consistently higher on the western shelf. The integrated community size frequency (ICSF) also shows that the western system is comprised of larger numbers of larger fish than the eastern system. This may be a reflection of the generally higher water temperature and

higher growth rates of the area. While average weight decreased for nearly all target species, only about half of the non-target species showed long-term declines. Average weights show some evidence of stabilizing or increasing during the period 1993 - 1995.

From 1970 to 1993, the demersal fish assemblages in both systems showed a marked decrease in the abundance of larger fishes. Both showed persistent increases in the steepness (slope) of the descending limb of the integrated community size frequency (ICSF). Since the imposition of the moratorium on fishing on the eastern shelf in 1993 and the concomitant restrictions on allowable removals on the western shelf, this trend shows some reversal during 1994 - 1998.

These changes in size spectrum were significantly correlated with trends in fishing effort for both halves of the shelf, explaining 60% and 79% of the variance in slope of the ICSF on the eastern and western shelf respectively. Although the overall level of fishing effort on the western shelf is approximately three times that on the eastern shelf, the rates of change in the slope of the ICSF over the study period did not differ significantly between the two systems. The slope of the ICSF was consistently steeper in the east.

One concludes that increasing fishing effort over the period 1975 - 1993 reduced the abundance of larger fish relative to smaller fish in the assemblages inhabiting the eastern and western reaches of the Scotian Shelf. For the smaller bodied, slower growing assemblage living on the cooler eastern shelf, this resulted in long-term declines in mean body size of all species and a rapid reduction of trawlable biomass during the late 1980's. For the larger bodied, faster-growing assemblage of the western shelf, long-term declines in mean body size are also apparent but declines in biomass are more gradual. These reductions in average body size and the abundance of larger specimens may have significant impacts on the ability of these species to rebuild or maintain population biomass and abundance.

Fishing on Ecosystems: the interplay of fishing and predators in Newfoundland-Labrador. Alida Bundy

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The Newfoundland-Labrador ecosystem was modelled for a time period in the mid 1980s, when the groundfish biomass was relatively stable. Since that time, this ecosystem suffered a catastrophic stock collapse in the cod fishery. Other groundfish stocks have also seriously declined, such as the American plaice and yellowtail flounder. The latter is perhaps now recovering. Whilst groundfish stocks have collapsed, seal populations and invertebrates such as shrimp and snow crab have increased in abundance. There has been great debate concerning the relative roles of fishing, predation and the environment in these dramatic changes in the ecosystem. This paper sets out to examine whether, and how much of, this change can be accounted for by the relative effects of predation and fishing. The system was modeled using the mass-balance model, ECOPATH 4.0 and the different sectors of the

fishery are explicitly defined. This balanced model is then used as the starting point for a simulation study using the dynamic simulation model ECOSIM. A series of "what if?" questions and simulations are posed to address the larger question, "can the effects of fishing (and predation) be shown to account for the changes observed in the ecosystem?

Ecosystem Effects of Fishing in the Eastern Bering Sea: Insights from Trophic Mass Balance Assessments. A.W. Trites, P. Livingston, M.C. Vasconcellos, S. MacKinson, A.M. Springer, D. Paulu

Major changes have occurred in the abundance of marine mammals, crustaceans and bottom fishing the eastern Bering Sea since the 1950s. Most notably, populations of whales, sea ions, fur seals, crabs shrimp and pelagic fishes have declined, while populations of flatfish and pollock have increased. We employed trophic mass-balance models (Ecopath and Ecosim) to examine the frequently proposed explanation that these changes were caused by human exploitation of top predators and/or a shift in the physical environment. Our mass-balance models indicate the Bering Sea ecosystem was more mature during the 1950s, before large-scale commercial fisheries were underway than during the 1980s, after many marine mammal populations had declined. Total catch in the eastern Bering Sea rose from 0.33 to 2.62 t $km^2$ between the 1950s and the 1980s. Exploitation during the 1950s used 47% of the net primary production, with most of it flowing through the harvested whales, compared to 6.1% during the 1980s when the emphasis switched to catching fish. Removing whales from the 1950s ecosystem had a positive effect on pollock by reducing competition for food. However, neither whaling nor commercial fisheries alone were sufficient to explain the 400% increase in pollock biomass and other observed changes. Trophic interactions alone cannot explain the magnitude of changes that occurred between the 1950s and 1980s. Our models suggest that other factors comprising of a regime shift, such as changes in water temperature or ocean currents must have been at play and may be far more important than trophic interactions in affecting the Bering Sea ecosystem.

The influence of fishing pressure on the spatial distribution and overlap between exploited and unexploited species on Georges Bank. L.P. Garrison

Georges Bank has been a site of intense fisheries exploitation for over two centuries. In recent decades, fishing effort has nearly doubled, while total landings and catch per unit effort have consistently declined. The abundance of commercially important species, particularly gadids and flounders, has dramatically decrease over the last thirty years, while the abundance of pelagic and elasmobranch species has concurrently increased. Reductions in species range and shifts in spatial distribution are generally associated with these declines in abundance. Species with a high degree of spatial overlap are most likely to have strong competitive and predator-prey interactions. The shift in spatial distribution associated with fishing pressure thereby creates the potential for cascading trophic effects that may influence the population dynamics of both exploited and unexploited species as well as the potential for stock recovery. We examined the changes in both spatial distribution and overlap between important exploited and unexploited species in the Georges Bank fish community. For

example, exploited stocks, notably Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), currently exhibit constricted spatial distributions and are concentrated into small areas of Georges Bank. Since these species have historically been the biomass domiants in the system, these changes in spatial overlap with unexploited species have important implications for the community structure and ecosystem dynamics on Georges Bank.

Diet shifts in fish species on Georges Bank during the last three decades: A shift in competitive interactions. L.P. Garrison and J. Link

Over the last three decades, the Georges Bank fish community has undergone dramatic shifts in species composition. The biomass of gadids (e.g. Atlantic cod and haddock) and flatfish (e.g., yellowtail flounder and winter flounder) have declined while elasmobranchs (e.g., skates and spiny dogfish) and pelagic species (e.g., Atlantic herring and mackerel) have increased and become the dominant biomass components. These shifts in species composition are generally attributed to the direct and indirect effects of intense exploitation in this system. We examined 25 years of the food habits of these fish to detect changes in diet and trophic structure on Georges Bank. Notable diet shifts among exploited and unexploited species may reflect changes in spatial distribution, alterations in the available prey field, and shifts in the strength of competitive interactions. The fish community is comprised of four major feeding guilds, across gradients and benthic to pelagic feeding and fish to invertebrate prey. Diet overlap matrices and changes in the guild structure index competitive interactions and trophic linkages over this time period. These dynamics are likely associated with the system-wide fishing pressure on the historically dominant species, and reflect a fishing inducted alteration of community and ecosystem structure.

Changes in piscivory associated with exploitation of the finfish community on Georges Bank. J.S. Link and L.P. Garrison

There are numerous and important piscivores in the Georges Bank fish community; predation accounts for a significant proportion of natural mortality on key fish stocks I this ecosystem. There has been a noticeable shift in the abundance of these predators during the last three decades that is generally attributed to fishing pressure. Although many fish persist as piscivores in this system (e.g., goosefish, sea raven, Atlantic cod, pollock bluefish, squids), not only has their relative abundance changed but their size composition has changed as well; both factors influence the effective predation by these fish. Additionally, major piscivores on Georges Bank also once included Atlantic halibut, summer flounder, and white hake but now include less valued longhorn sculpin, spiny dogfish, Atlantic mackerel, Atlantic herring, and various skates. To ascertain the cascading effects of fishing on fish predation, we examined the diet composition matrices, an index of mutual predation, the average condition factor of predators, total stomach contents, and provisional consumption rates for these species across this time period. Fishing mortality is usually larger in magnitude than natural mortality (except in a few instances), yet we know that predator-prey interactions determine the multi-species trajectory of an ecosystem, particularly the recovery of valuable stocks. Our analysis

demonstrates important changes in predator-prey interactions, suggesting that top-down impacts from exploitation have affected population dynamics, biomass partitioning, yield potential, and energy flow in this ecosystem.

Overview of food web dynamics in the Northwest Atlantic: detecting changes in key processes and parameters in a multi-species context. J.S. Link, F.P. Almeida, C.G. Milliken and L.P. Garrison

The fish component of the northwest Atlantic continental shelf ecosystem has undergone well-documented changes over the past three decades. Particularly, gadids, flatfish, and other demersals are less abundant whereas smaller pelagics and elasmorranchs are more abundant than historical levels. In addition to abundance, we monitor several diet parameters including percent diet composition, percent prey frequency, total stomach contents, predator size, and prey size to estimate and assess major processes and rates for key fish in this ecosystem. Some of the major processes and rates we examine from these parameters are: 1) trophic links and interaction strengths for multi-species models, 2) food web statistics, 3) M vs. F, 4) the partitioning of energy, biomass, and yield, 5) recruitment bottlenecks, 6) essential fish habitat, and 7) consumption, predation, competition and production rates. Our time series extends for 25 years, contains more than 100 predators and 1200 prey items, ranges from Cape Hatteras to Nova Scotia, covers over 83,700 square nautical miles, and spans the period and locale of intense perturbation on the fish community of this ecosystem. Changes in these key processes and rates are not trivial to detect at these spatial and temporal scales, but if observed, as they have been in this ecosystem, allow quantification of the effects of over-exploitation and more importantly provide an assessment of the potential for recovery of economically important fish stocks. This example demonstrates the value and utility of maintaining long-term, broad-scale monitoring efforts.

Effects of 500 years of fishing on Newfoundland marine ecosystems. G.A. Rose.

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The Newfoundland and Grand Banks ecosystems have supported important fisheries, primarily for Atlantic cod, for 500 years. Fisheries for whales, seals, herring and capelin were also prosecuted historically. Haddock, redfish and flatfish fisheries began in mid-20$^{th}$ century. More recently, fisheries for pelagics and crustaceans dominate production. Many fluctuations in historical cod landings coincide with wars, market changes, and often follow climate variations (a persistent ca. 20 year cycle exists in the cod landings over 500 years). Long-term periods of high and low productivity as evidenced in tree-ring data are evident in cod landings. Historical patterns in the catch record also suggest that substantial ecosystem change has occurred within the past 50 years. The most severe changes, during the past 50 years, follow unprecedented levels of fishing during a period of poor productivity. Ecosystem changes include: 1) overall yield declines; 2) trophic structure deflation from pyramidal to "hour-glass" shape; 3) commercial extinctions of mid-trophic level species (e.g., haddock,

redfish, cod), and increases in some lower trophic level species leading to new fisheries (e.g., snow crab and shrimp). I attempt to reconstruct the sequence of events leading to ecosystem change.

Quantification and dynamics of indicators of ecosystem health, goods & services: the Georges Bank and Gulf of Maine example. J.S. Link

Ocean ecosystems provide unique and numerous services and products. Notable examples of obvious economic consequence are food (both finfish and invertebrate fisheries), tourism, navigation and transport, sport-fishing, mineral harvest, while less obvious examples are atmospheric C02 scrubbing, eco-tourism (e.g., whale-watching), and other recreational, pleasure, and aesthetic activities. Underpinning these examples are food web structures and dynamics. Examination of key indicators, including primary production stability, sources of natural mortality, community evenness and diversity, "canary" populations, modal trophic level, degree of cannibalism, viable "charismatic megafauna" populations, food web connectivity, species interaction strength, and size at age of key fish stocks gives an assessment of ecosystem health and thus an ecosystem's ability to sustain production of key goods and services. The Georges Bank-Gulf of Maine ecosystem has undergone well documented changes over the past 30 years that are primarily attributed to exploitation of fish stocks. Changes in ecosystem indicators demonstrate that this food web has altered drastically, that ecosystem goods and services are distinct from historically higher valued products, and returning to a desired state of "health" will continue to be a challenge for fisheries management in this system.

Integrating Ecosystem Considerations into Groundfish Fisheries Management off Alaska, USA. David Witherall and Clarence Pautzke

Ecosystem considerations factor into the management of groundfish fisheries in the North Pacific Ocean off Alaska, USA. The Council's ecosystem-based management approach involves public participation, reliance on scientific research and advice, conservative catch quotas, comprehensive monitoring and enforcement, bycatch controls, gear restrictions, temporal and spatial distribution of fisheries, habitat conservation areas, and other biological and socioeconomic considerations. The most basic ecosystem consideration employed is a precautionary approach to extraction of fish resources. Off Alaska, all groundfish stocks are considered healthy, while providing sustained yields of over two million metric tons annually. Management measures are also taken to minimize potential impacts of fishing on seafloor habitat and other ecosystem components such as marine mammals and seabirds. A review of the Council's ecosystem approach will be provided (in English).

A Fisheries Ecosystem Plan for the Northern California Current. Elizabeth H. Linen and Robert C. Francis

Fishing pressure in the Northern California Current Ecosystem (NCCE) has been intense for decades and the possibility of consequent large-scale ecosystem changes is large. NCCE fisheries management has been almost exclusively governed by the use of single species models that are inadequate for assessing the ecological costs associated with fishing. Little is understood about the status of NCCE fish populations, but limited stock assessments and fisheries data illustrate that fluctuations in harvested populations may be rapid, highly variable, and undesirable. In order to account for larger scale ecosystem changes, fisheries management needs to move from a myopic single-species perspective to a more holistic approach. This change in outlook will require a dramatic shift in research and management objectives. Critical steps towards the development of more holistic ecosystem management practices in the NCCE involve quantitatively defining trophic structure, scale, and dynamics, and linking scientific findings with human management institutions. This paper documents a developing research project designed to advance these objectives. The primary goals of this project include: (1) modeling the large-scale structure and dynamics of the Northern California Current Ecosystem (NCCE), (2) determining the impacts of fishing on NCCE trophic structure and dynamics, (3) providing a first attempt at designing significant qualitative and quantitative aspects of a regional Fisheries Ecosystem Plan (FEP) as recommended by the National Marine Fisheries Service Ecosystem Principles and Advisory Panel (EPAP), and (4) conveying models and findings to fisheries managers and policy makers through comprehensible dynamic computer visualizations. This research agenda will help facilitate the crucial transition from "species management" to "ecosystem management," thereby setting a valuable precedent for the management of marine ecosystems worldwide.

Ecosystem Considerations in Fisheries Management: Linking Ecosystem Management Goals with Ecosystem Research. Patricia Livingston

As fishery management organizations move towards ecosystem-oriented management, there is a need to more clearly define the ecosystem management goals of the organization and the tools available to managers to attain those goals. Parallel to this must be an expansion of the scientific advice provided to management beyond traditional single-species stock assessment advice. Although there have been advances in multispecies and ecosystem modeling approaches, these approaches have not yet been completely embraced by the fishery management community. In some cases this is so because of the difficulties in validating these models and in other cases because of the lack of sufficient data and knowledge of the critical processes to develop an appropriate model. Progress can be made, however, in providing ecosystem advice to managers while we wait for these approaches to mature. The burgeoning GOBEC and GLOBEC-like research efforts going on throughout the world, increasing emphasis on habitat research, ongoing trophic interactions work, and long-term monitoring of non-commercial species all provide useful information on ecosystem status and trends. Some of this ecological information can be used to gauge the success of various management schemes that have been put in place to meet ecosystem management goals. The

North Pacific Fishery Management Council (NPFMC) has started to include some of this ecosystem research information in an ecosystems considerations document that supplements the traditional single-species stock assessment reports. I outline here a proposed revision of the ecosystem considerations document of the NPFMC that will include ecosystem status and trend information and link management actions with ecosystem observations and discuss the benefits to scientists and management of such an approach.

Community-Based Management Reveals the Need for Local Ecosystem Research: A case study from the Canadian Bay of Fundy. Maria Recchia

A group of independent fishermen conducting community-based management (CBM) determined the necessity of local ecosystem research to the management of their fisheries. The SWNB (Southwest New Brunswick) Fixed Gear Groundfish Board, a group of fishermen representatives from the Canadian Bay of Fundy, work together to design, implement, and enforce fisheries management rules in their local communities. In the process of decision-making, the board members discovered that they needed detailed ecological information in order to make sensible conservation-minded rules. The desired information included predatory-prey relationships, migration patterns, and local stock structure. Much of this information either had never been documented or was in scientific debate. Consequently, the group began conducting their own local-level research utilising both TEK (traditional ecological knowledge), and joint fisher-scientist research. The subject of the first project was a local run of every large cod. Initially, open-ended interviews were conducted with active and retired fishers to examine the possibility that this fish run is distinct from the larger retinal stock. In the course of the qualitative phase of this research a variety of information emerged including the cod's relationship to feed species, migration patterns, the effects of pollution, and oceanographic factors. The depth and breadth of the information gathered is of great interest, and has led to several other research projects. This qualitative data served as a basis for scientific data collection, jointly conducted between the Canadian Department of Fisheries and Oceans (DFO) and the local fishermen. However, the interviews provided more than a focus for scientific study as the documented TEK gives valuable insight into the functioning of the larger ecosystem.

The Role of Developing Species Advisory Boards in Eastern Canadian Exploratory Fisheries. Odette Murphy[1]

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Developing Species Advisory Boards (DSAB) were first established in 1995 in the Scotia Fundy Sector of the federal Department of Fisheries and Oceans (DFO) in eastern Canada, to provide a forum for review of industry proposals to conduct exploratory fisheries. The DSAB are joint government/industry boards which have multi-sector representation, including both federal and provincial levels of government, the harvesting and processing sectors, and Aboriginal First Nations. These boards have been instrumental in guiding the

successful development of many new, exploratory fisheries directed at species not previously harvested in Scotia-Fundy waters. This poster elaborates on the structure, role and process of the DSAB, as well as on key elements and benefits of the approaches and policies adopted in respect of exploratory fisheries.

Evaluating the Effects of Community Management Boards on the Overall Management System of Fixed Gear Groundfish in Scotia-Fundy. Lucia Fanning

A recent review of groundfish management I the Scotia-Fundy Region has prompted the need for a better understanding of the effect of Community Management Boards o the overall management system of fixed gear groundish in the area.

For the past two years, the fixed gear groundfish quota in the Scotia-Fundy 4X5Y divisions NAFO designated zone for vessels less than 45 feet has been sub-allocated to eight "communities", based largely on catch history. As such, the "communities" are comprised of license holders from various geographic areas within Scotia-Fundy. To address this delegation of responsibility by DFO to the users of the resource, each "community" has responded by developing a structure that facilitates the meeting of two DFO-imposed criteria, namely: the development and implementation of conservation harvesting plans; and, the recommendation of allocation of the quota amongst members of the "community", i.e. licence holders.

With an operational history of approximately two years, this study examines the significant lessons which can be revealed and benefits obtained to both DFO and the communities of resource users from an analysis of this experimental approach to the management of fixed gear groundfish quota. These include: The value of co-management as a successful paradigm for this type of fishery; an identification of the factors that must be put in place (both within DFO and the "communities") to facilitate success when aspects of management responsibility are devolved to "communities"; an identification of the social costs and benefits of such an approach to resource management; an awareness of the respective contribution of causation factors, external to the designed experiment, which may impact, significantly on the experiment's success and in evaluating cause and effect linkages.

The St. Georges Bay Ecosystem Project (GBEP): An Illustration of Building Partnerships in Fisheries Management through Interdisciplinary and Stakeholder Participation in Ecosystem Analyses. Anthony Davies and Nell den Heyer

Over the last 12 months a group of university-based social and natural science researchers has developed a collaboration with native and non-native marine harvesting organizations and a branch of the fisheries science agency of the Canadian Department of Fisheries and Oceans (DFO) that is focused on providing an ecological understanding of the St. Georges Bay system and fisheries. St. Georges Bay, centered in the northeastern Nova Scotian shore of the southern reaches of the Gulf of St. Lawrence, is a large and complex system that remains the site of fisheries ranging from First Nations estuarine eel harvesting, through

various pelagic and demersal fisheries to major lobster harvesting activities. The St. Georges Bay Ecosystem Project (GBEP), facilitated by the Interdisciplinary Studies in Aquatic Resources (ISAR) program at St. Francis Xavier University, is building an interdisciplinary and 'working' collaboration between university researchers, native and non-native harvesters and governmental scientists. This collaboration was initiated through several ecological concerns posed by marine harvesters and their organizational leadership. Both ISAR and DFO linked researchers recognized this as an opportunity to participate in building a problem-centered and research-focused collaboration with Native and non-Native marine harvesters. This collaboration has been approached by all partners as a ways and means to developing an ecologically-referenced approach to understanding fisheries and to achieving sustainable marine resource management. The poster will detail the GBEP process and its substantive developments to date, as well as review some of the key expected outcomes.

Seabird-Fisheries Interactions in Atlantic Canada. John W. Chardine[1]

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Seabirds are marine organisms, which spend most of their time at sea and feed on fishes and marine invertebrates. They are protected under the federal Migratory Birds Convention Act, administered by the Canadian Wildlife Service, Environment Canada. Fisheries-related conservation concerns for seabirds in Canada currently focus on bycatch and competition for food.

Globally, seabirds are frequently drowned in fishing gear or caught on longline hooks. Very little information exists on the extent of seabird bycatch in Canadian fisheries due to lack of monitoring. Canadian Wildlife Service studies in 1980s showed that murres, puffins and shearwaters were the most frequently caught, and that population-level impacts were occurring. Monofilament gill nets and salmon nets set close to breeding colonies or in good feeding areas caught most birds. There are few bycatch data for other fisheries such as east coast tuna and swordfish longline fisheries, but species such as shearwaters and fulmars could be caught. We need to conduct assessments of seabird bycatch in Canadian fisheries and routinely monitor bycatch, as is done for example in the US as part of fisheries monitoring. We also need to reduce the use of monofilament gillnets, and eliminate them from the vicinity of breeding colonies when forage fish are "running". We need limits for bycatch of threatened seabird species, and the development of "seabird-friendly" fishing gear.

Healthy seabird populations rely on adequate supplies of food such as small, forage fishes, which are an important part of seabird diet in most areas of Atlantic Canada. For example, seabirds make extensive use of herring, capelin, and sand lance. Fisheries for herring and capelin are ongoing in Atlantic Canada, and reductions in stocks of these forage fish could have negative effects on local seabirds. We should adopt true multi-species approaches to fisheries management, in which non-fish predators such as seabirds are considered. Forage fish stocks need to be managed so as to provide adequate food supplies for seabirds and other non-fish predators. It should be noted that because the success of seabirds is tightly coupled

with their food supply, they provide excellent, cost-effective indicators of the abundance of forage-fish species.

Effective ecosystem approaches to fisheries management must take into account and mitigate fisheries effects on all components of the marine ecosystem, including non-fish species such as seabirds.