GLOBAL AND NATIONAL DEVELOPMENTS TOWARD AN ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT: AN AUDIT OF THE GRAND MANAN, NEW BRUNSWICK GROUNDFISH GILLNET FISHERY

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Global and national developments toward an ecosystem approach to fisheries management:

An audit of the Grand Manan, New Brunswick groundfish gillnet fishery

by

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Abstract:

One of the most significant management challenges facing the Canadian fishing industry is meeting increasingly rigorous national and international standards. Balancing a broader suite of conservation, social and economic objectives in an ecosystem approach is a challenge faced by both harvesters and managers. This paper reviews and summarizes the foundations of an ecosystem approach for fisheries (EAF). It has consolidated and articulated the conservation, social and economic objectives that are required to be incorporated into fisheries management in order to be considered an EAF for Canadian fisheries. For the first time, a summary of what has been implemented in Canada was described and then compared to an EAF framework method being promoted by Food and Agriculture Organization (FAO). Finally, an audit of an existing Canadian fisheries management plan was undertaken. This audit demonstrated that there have been positive steps made toward implementing an EAF for the Grand Manan Gillnet Fishery, however more work is required in order to meet the minimum requirements for an EAF as established in this work.

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Dedicated to Freda Margaret Waters (1947-2007).

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AFPR	Atlantic Fisheries Policy Review
CBD	1992 Convention on Biological Diversity
CHP	Conservation Harvesting Plan
ESD	Ecological sustainable development
EAF	Ecosystem approach to fisheries management
DFO	Fisheries and Oceans Canada
FAO	Food and Agriculture Organization
IFMP	Integrated Fisheries Management Plan
MSE	Management strategy evaluation
MSC	Marine Stewardship Council
NOAA	National Oceanic and Atmospheric Administration
NSESD	National Strategy for Ecological Sustainable Development
SARA	Species at Risk Act
SAR	Science Advisory Report
SFF	Sustainable Fisheries Framework
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ICES	International Council for the Exploration of the Sea
UN	United Nations
UNCED	United Nations Conferences on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea

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1.0 Introduction

There is a high demand for fisheries management systems to incorporate more holistic approaches when managing fisheries. No longer can this demand be ignored. Increasingly, policies and legislation are dictating a more comprehensive approach to address fishery problems, taking the ecosystem as a whole into account (Aqorau, 2003) and including more social and economic objectives in management. Balancing a broader suite of ecosystem, social and economic objectives is a challenge faced by the fishing industry and those who manage them. International guiding principles for fisheries policy and management have been developed by various groups. Nationally, Canada has ratified some of these policies and developed its own suite of policies and legislation that build upon various international guidelines. However, globally, implementation of these guidelines at operational levels is still slow or absent in many cases (Garcia and Moreno, 2003). In Canada there is a need to move forward in fisheries management, to ensure that the intent of the international guidelines and national legislation is being met.

The ecosystem approach to fisheries management (EAF) is considered a method to implement the international instruments. It can be considered more than a management framework but a 'way of thinking' similar to the 'green' movement (discussed in Section 2.1.7), that can be adopted by all fisheries (De Young et al., 2008). However, some questions remain; what is the minimum that is required to fulfill obligations in

implementing an EAF and has Canada evaluated their fisheries to ensure that these minimum requirements are being met?

This work documents the foundations of an (EAF). It summarizes what is being implemented by Fisheries and Oceans Canada (DFO) Maritimes Region, and compares this to the EAF being implemented in Australia, a method that is being promoted by Food and Agriculture Organization (FAO) (Bianchi, 2008). Through this evaluation it has been concluded that in addition to broader conservation objectives, more specific and developed social and economic objectives are necessary in order to achieve a true EAF. This evaluation consolidates what the conservation objectives are, and articulates what the social and economic objectives should be for Canadian Fisheries, a challenge few authors have undertaken. Finally, an audit of a currently operational fisheries management plan is completed to determine how well that the Grand Manan Gillnet Fishery is meeting the requirements of an EAF as established in this paper.

2.0 Changing Trends in Fisheries Management.

FAO has estimated that 50 percent of the world's marine resources are fully exploited, 25 percent are over exploited and 25 percent could potentially support higher exploitation rates (FAO, 2005A; FAO, 2006). This has raised concern about the failure of traditional management systems and has led to calls for new methods to manage fisheries (Hilborn et al., 2003). Despite an increase in fishing effort, the global marine catch has been stable for over a decade while at the same time, the production of the oceans has been in decline

(World Bank, 2008; Willmann and Kelleher, 2010). This loss was estimated by the World Bank (2008) to be approximately 50 billion US dollars annually.

2.1 The Foundations of Ecosystem Approach to Fisheries Management

Increasingly, international policies and conventions require that management authorities take a more holistic approach to solving fishery problems, and to consider the ecosystem as a whole (Aqorau, 2003; Bianchi et al., 2008). These initiatives began with the 1982 United Nations Convention on the Law of the Sea (UNCLOS) (http://www.un.org/Depts/los/index.htm/) (Caddy, 1999; Aqorau, 2003; Garcia and Moreno, 2003). Other conventions have built upon the UNCLOS agreement including, the Biodiversity Convention in 1992 (http://www.cbd.int/), The United Nations (UN) Fish Stocks Agreement and the FAO Code of Conduct for Responsible Fisheries in 1995 (Caddy, 1999; Aqorau, 2003; Garcia and Moreno, 2003). The institutional basis for ecosystem-based governance of fisheries has already been adopted at the highest levels of government, but implementation is still slow or absent in some cases (Garcia and Moreno, 2003). Implementation requires political will, resources and a high level of commitment (Garcia and Moreno, 2003).

Different authors have placed emphasis on a variety of initiatives as the foundations to ecosystem-based fisheries management. The various instruments are in themselves complex, and form an inter-related network of global ocean policy (Turrell, 2004), each one relying and drawing from the others. Garcia et al., (2003) identified the two main roots of ecosystem management as the UN conference on Human Environment in 1972,

and UNCLOS in 1982. Caddy (1999) identified four international agreements since UNCLOS that provided the comprehensive foundation for ecosystem-based management. These include: Agenda 21 of the UN Conferences on Environment and Development (UNCED), the Biodiversity Convention, the UN agreement on the Straddling Fish Stocks and Highly Migratory Fish Stocks and the FAO Code of Conduct for Responsible Fisheries. Turrell (2004) described how ecosystem-based fisheries management evolved in three initiatives, all of which were lead by the UN and categorized into the UNCLOS process, the UNCED process or the FAO process. The most significant convention identified by Aqorau (2003) was the 1992 Convention on Biological Diversity (CBD).

UNCLOS provided the legal foundation on which governments can build a new system of governance (Garcia and Moreno, 2003). It formulated, *inter alia*, the basis for conventional fisheries management and it identified the need for restoration of depleted populations, the interdependence of stocks (i.e. in article 61.3) and the issue of associated dependant species (Art. 61.4 and 119.1.b). In addition, it stressed the obligation to protect and preserve the environment (Part XXII, Art. 192 and 193) (Garcia et al., 2003). UNCLOS is considered the international constitution of the oceans, incorporating both the codification of customary international law and negotiated treaty commitments relating to the world's oceans (Canada, 2002A).

Although, UNCLOS provided the legal foundations enabling a new system of governance, it is out of the UN Conferences on Environment and Development (UNCED) that the fundamentals of the 'ecosystem approach' emerged (Turrell, 2004). UNCED

initiatives include, among others, the Biodiversity Convention (1992), Agenda 21 (1995), the UN Fish Stock Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995) and the 1995 Jakarta Mandate on Marine and Coastal Biological Diversity (Garcia et al., 2003). These initiatives, along with The Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem, are considered by many to be the foundations of ecosystem based management for fisheries (Bianchi, 2008). They are summarized with some of the most relevant points in relation to fisheries and an ecosystem approach highlighted.

2.1.1 United Nations Convention on Biological Diversity (1992)

UN Convention on Biological Diversity (CBD) (1992) acknowledged the intrinsic value of biological diversity to humankind, and that its conservation is a common concern to humanity. The Convention did not discriminate between terrestrial or marine biological diversity. The three objectives of the convention were stated as being the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of its benefits (Agenda 21, 1995; Garcia et al., 2003; Turrell, 2004). In relation to an ecosystem-based approach the CBD called for cross-sectoral, integrated management, involving stakeholders and the private sector (principles 6 and 10) (Turrell, 2004). It complemented, built upon and reinforced the UNCLOS agreement (Garcia et al., 2003). CBD provided an international framework for the conservation, ecologically sustainable development and use of living resources (Aqorau, 2003). Parties are obliged to regulate and manage processes affecting, or likely to affect, biodiversity in an adverse manner (Aqorau, 2003). It stated that scientific uncertainty should not prevent any action needed

to conserve biodiversity and suggested the use of tools such as protected areas (Aqorau, 2003; Turrell, 2004).

2.1.2 Jakarta Mandate on Coastal and Marine Biodiversity (1995)

The 1995 Jakarta Ministerial Statement on the Implementation of the Convention on Biological Diversity (Jakarta Mandate on Coastal and Marine Biodiversity) (Aqorau, 2003) established a global consensus on the importance of marine and coastal biodiversity (Aqorau, 2003). The mandate specifically linked conservation, the use of biodiversity and fishing activities. It promoted integrated management and marine protected areas as tools to achieve the objective of ecological and sustainable use of marine and coastal living resources (Aqorau, 2003).

2.1.3 Agenda 21 (1995)

Agenda 21 (1995) called for an ecosystem approach to ocean management (Garcia et al., 2003). Integrated management and sustainable development were promoted. It discussed, among other things, strengthening of conventional management as well as multi-species management, consideration of associated and dependant species, relations between populations, restoration of depleted stocks, improvements of selectivity and reduction of discards, protection of endangered species and habitats, and prohibition of destructive fishing (Garcia et al., 2003). Chapter 17 titled 'Protection of the Oceans' is of particular relevance for fisheries. It called for new approaches to marine and coastal area management and advocated integrated and precautionary approaches. The movement toward 'responsible fisheries' started at UNCED and with Agenda 21 (Caddy, 1999).

2.1.4 United Nations Fish Stock Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995)

The failure of UNCLOS to prevent overexploitation of fish stocks, especially highly migratory and straddling fish stocks on the high seas, led to negotiations of the UN Fish Stock Agreement (Aqorau, 2003). The fundamental objective of this agreement was to ensure long-term conservation and sustainable use of straddling fish stocks through effective implementation of the provisions set forth in UNCLOS (Aqorau, 2003; Garcia et al., 2003; Turrell, 2004). The Fish Stock Agreement was developed in parallel with FAO guideline for responsible fishing (Caddy, 1999). Its implementation was believed to strengthen the global application of ecosystem-based management (Aqorau, 2003). The theme of protection of the marine environment and habitat is evident in this agreement (Aqorau, 2003). For example, parties must assess the impacts of fishing, other human activities and environmental factors on target species, species that are part of the same ecosystem, and species that are associated with or dependant upon target species (Aqorau, 2003). Detailed for the first time are methods for the application of the precautionary approach (Garcia et al., 2003).

2.1.5 The FAO Code of Conduct for Responsible Fisheries (1995)

The Food and Agriculture Organization of the United Nations was founded in 1945 with the intent of raising the level of nutrition, standards of living and productivity to improve living conditions of rural populations (FAO, 2005A). The FAO is one of the lead agencies for agriculture, forestry, fisheries and rural development.

The FAO Fisheries Department developed a document which has provided a voluntary framework for fishing responsibly. This document titled "The Code of Conduct of Responsible Fishing" could be used by all stakeholders on every scale from local to global. It is seen by some as the most complete and operational reference for the management of fisheries (Garcia et al., 2003).

The Code is a guideline and it provided standards of conduct for all persons in the fisheries sector. It stated that the right to fish carries with it the obligation to ensure conservation and management of the ecosystem (FAO, 1995; Turrell, 2004). The principles of the Code take into account relevant biological, technological, economic, social, environmental and commercial aspects (FAO, 1995). It promoted protection of living aquatic resources as well as their environments, and it provided a map to the implementation of a more holistic ecosystem management (FAO, 1995).

The Code offers a sustainability framework that is subdivided into operational articles: (1) Fishing operations, (2) Fisheries management, (3) Integration of fisheries into coastal area management, (4) Post-harvest practices and trade, (5) Aquaculture and development, and (6) Fisheries research (Garcia and Staples, 2000). This is intended for implementation and corresponds to the stakeholders who should implement the code (i.e. fishermen, processors, managers, traders, fish farmers and researchers) (Garcia and Staples, 2000). The Code is supported by a series of technical guidelines to facilitate its implementation.

The guidelines call for specific targets, criteria and indicators and are continually being refined (Garcia and Staples, 2000).

2.1.6 Reykjavik Declaration (2001)

The Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem was held in 2001. The purpose of the conference was to gather and review the best available knowledge on marine ecosystem issues, identify means to consider the ecosystem in fisheries management and identify the future challenges faced by marine ecosystem management (FAO, 2003A). It concluded that, more than ever, there was a need to consider the marine ecosystem in its totality when making decisions.

The Reykjavik declaration specifically stated that "in an effort to reinforce responsible and sustainable fisheries in the marine ecosystem we will individually and collectively work on incorporating ecosystem considerations into management". The Reykjavik conference and declaration are considered to be a milestone for placing ecosystem considerations as the focus of current fisheries management (Bianchi, 2008).

2.1.7 Eco-labeling and Consumers

Consumers' attitudes are dynamic; this can be reflected by their demands in the market place. Over the last three decades, consumers have become more informed about global and environmental issues (Cole-King, 1993). As a result there has been an effect on consumer demand, and consequently, this has directly affected the fishing industry.

Eco-labelling cannot be directly related to a particular conference or meeting. However, its application to fisheries attracted international attention following Agenda 21 where governments agreed to encourage expansion of environmental labelling to assist consumers to make informed choices (Garcia et al., 2003). In March 2005, the FAO committee of Fisheries adopted a set of voluntary guidelines for the eco-labeling of fish products (FAO, 2005B).

Certifying groups such as the MSC use a logo on packages of seafood that will serve to provide consumers with the assurance that their purchase meets certain standards (Long, 1999). This allows consumers to exercise their influence in encouraging responsible fishing practices and management (Long, 1999). Ideally, eco-labelling provides the fishing sector with an additional incentive to act responsibly and makes it easier for politicians to implement unpopular policies (Long, 1999). In fact, certification is now considered necessary for market entrance and no longer just for added value (K. Graham, DFO, Personal Communication, May 12, 2006). For many fisheries managers and industry, it is now a reality that the values of their products are directly related to their management performance as assessed by eco-certification companies and other interest groups (T. Hooper, Connors Bros., personal communication, May 14, 2006). Ward and Phillips (2010) predict that within a decade it seems unlikely that commercial wild capture fisheries will be able to operate successfully without some form of certification or ecolabel.

One criticism of such groups was that certification ignored the rest of the production chain, and in doing so may mislead consumers into thinking the products that they purchase have had no environmental costs whatsoever (Agardy, 2003). Another issue is that there is little empirical data on eco-labeling programs that confirm that there are any significant environmental improvements achieved through eco-labeling of products (Phillips et al., 2003; Ward and Phillips, 2010).

2.2 National Progress Toward an Ecosystem Approach to Fisheries Management

Although the Fisheries Act is over a century old, it remains the primary legislative basis for fisheries management in Canada (Parsons, 1993). The adoption of the Oceans Act in 1997 and the Species at Risk Act in 2002, extended the role of the Department of Fisheries and Oceans in managing the use of marine resources and habitats, and provided the legal tools to accomplish their objectives.

2.2.1 Species at Risk Act (2002)

The Species at Risk Act, or SARA was first introduced into the House of Commons in February of 2001 and Senate deliberations resulted in royal assent of the Act on December 12, 2002. The Act grew from numerous cross-Canada consultations and built on the policy of previously unsuccessful legislative proposals regarding species at risk over a nine-year time frame (Canada, 2002B). Members of the commercial fishing industry are among the Canadians most directly affected by the Species at Risk Act (DFO, 2005).

The overall goal and mandate of SARA is to prevent wildlife species from becoming extinct or lost from the wild, and to help the recovery of species that are at risk as a result of human activities. SARA provided a framework for actions to ensure the survival of wildlife species (Canada, 2003). This Act built upon and complimented other laws and acts that are already in existence such as the Fisheries Act, Migratory Bird Convention Act, and the National Parks Act (Canada, 2002B).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) evaluates and makes recommendations to government on whether a species should become listed. Operating at an arms length from government, it assesses and classifies wildlife species using the best scientific knowledge, community and aboriginal knowledge (COSEWIC, 2005). It has assessed over 600 species in its 25-year history (Environment Canada, 2002).

The government is responsible for deciding whether a species is actually placed on the protection list. Once a species is placed on the protection list it becomes illegal to kill or harm the species or its residence. However, there is a clause that states that the government may issue a permit to allow for incidental harm to a listed species. This becomes a particular issue in such cases as fisheries bycatch. The minister of DFO can issue permits under SARA which allow a limited amount of bycatch of a listed species, so long as the level of bycatch does not jeopardize the survival or recovery of the species (DFO, 2005). These permits are granted only after DFO conducts a scientific assessment

to fully understand the impact of commercial fisheries on listed species at risk (DFO, 2005).

DFO's roles and responsibilities within SARA involve all aquatic species. Aquatic species to be protected include fish or marine plant species defined under the federal Fisheries Act, and have been assessed against COSEWIC's classification criteria. In 2010, there were 97 aquatic species listed under SARA (DFO, 2010).

A recovery strategy is a document that outlines short-term objectives and long term goals for protecting and recovering species at risk (DFO, 2004A). It is prepared in partnership with provinces, territories, wildlife management boards, aboriginal organizations, land owners, fishing interests, universities, industry, environment groups and other appropriate individuals. For all species listed under SARA a recovery strategy must be prepared within one year for endangered species (a species facing imminent extinction or loss from the wild in Canada) and 2 years for threatened species (a species that is likely to become endangered if limiting factors are not reversed). A management plan must be prepared for species in the special concern category (has characteristics that make it particularly sensitive to human activities or natural events) within three years. Five years after a recovery strategy, action plan or management plan come into effect, the Minister must report on the implementation and the progress toward meeting those objectives.

2.2.2 Oceans Act (1996)

Canada's Oceans Act received Royal Assent in the House of Commons in December 1996. This Act made Canada the first country in the world to have comprehensive oceans management legislation (Canada, 2002A). The oceans policy document, *Canada's Ocean Strategy*, was developed to aid in the implementation of the Oceans Act.

The Act is based on three principles of sustainable development, integrated management and the precautionary approach (Canada, 2002A), and three policy objectives of understanding and protecting the marine environment, supporting sustainable economic opportunities and providing international leadership. The strategy is also designed to advance the international drive to strengthen the oceans governance regime. The rights and obligations under international conventions and agreements are fully recognized and respected under the Oceans Act and Canada's Ocean Strategy.

The responsibility of the implementation of the Oceans Act lies with the Minister of Fisheries and Oceans, in collaboration with other federal, provincial and territorial governments, as well as with affected Aboriginal organizations and groups with vested interest. It is also the responsibility of the Minister to facilitate the development and implementation of an integrated management plan for managing all activities and measures that affect Canadian waters.

The Oceans Strategy states, among other things, that Canada promotes the understanding of oceans, including ocean processes, marine resources and marine ecosystems. It states

that Canada will foster the sustainable development of the oceans and their resources; that conservation, based on an ecosystem approach, is of fundamental importance. Furthermore, it states that while implementing these goals, Canada will use the wide application of the Precautionary Approach and promote the integrated management of oceans and marine resources. It provided DFO the legislative ability to protect the marine environment through marine protected areas.

2.2.4 Fisheries Renewal: Fisheries and Oceans Canada (2009-2011)

The Atlantic Fisheries Policy Review (AFPR) began in 1999 and was one of the regional renewal initiatives that were incorporated into the national fisheries renewal effort. The AFPR was intended to modernize the group of policies that govern Atlantic Canadian fisheries. The objectives of AFPR were rooted in conservation and participatory management of the resource and self reliance of the industry. In addition, it was intended to make the decision-making process more transparent and predictable.

Although not the primary focus of the AFPR, the concept of integrated management was addressed in the policy. It acknowledged that although commercial harvesting is the prevailing use of fisheries resources on the Atlantic coast, the management of the fisheries needed to accommodate a growing number of uses that also contribute to the Canadian economy (Canada, 2004). Such activities include aquaculture, recreational fishing, oil and gas exploration and marine tourism (Canada, 2004). Consequently, the AFPR recommended, an integrated management system to properly manage coastal and ocean uses.

Within the last few years, DFO commenced the integration of regional policy renewal efforts (i.e. AFPR) and incorporated emerging issues into a new initiative entitled Fisheries Renewal. The objectives of this renewal were documented to be long-term sustainability by incorporating the ecosystem and precautionary approaches; economic prosperity by aligning fisheries policies and decision-making processes to support economically prosperous fisheries; and improved governance by increasing transparency and accountability in fisheries management and by promoting shared stewardship (DFO, 2009A).

The Sustainable Fisheries Framework (SFF) is the core of Fisheries Renewal. It is a national framework that is intended to form the basis for decision-making for all Canadian fisheries. It was first published on the internet in spring of 2009 (http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/overview-cadre-eng.htm).

SFF's primary goal is to ensure that Canadian fisheries are environmentally sustainable, while supporting economic prosperity. It incorporates existing policies for fisheries with new and evolving policies (DFO, 2009A). The Framework consists of four groups of policies: conservation and sustainable use policies; economic policies; governance policies and principles; and planning and monitoring tools.

The most recently published policies are regarding forage species, incorporating a precautionary approach and managing the impacts on benthic habitat, communities and species.

3.0 Expanded Management Objectives

Seen as the traditional fisheries objective, maintaining target species productivity has been the primary goal of many fisheries management systems. Clearly, this approach has not been enough to sustain all fisheries. In an effort to improve management, an expansion to include more ecosystem, social and economic objectives has been called for by many (FAO, 2003A; FAO, 2003B; Bianchi et al., 2008).

Implicit in the global trends and national progress discussed above, is that conservation is the underlying theme that is embedded within these policies. There is recognition of the need to put a suite of ecosystem objectives into practice including objectives that not only include single species productivity, but also include objectives related to biodiversity and habitat. Within the Fisheries Renewal initiative, Canada has adopted these conservation objectives in an effort to move toward an EAF.

Ecosystem-based management cannot be realized without incorporating social and economic objectives into management (De Young et al., 2008). Yet, the level of development on these objectives is varied (Cochrane and Garcia, 2009).

3.1 Conservation Objectives.

The emerging consensus is that the essential conservation components of ecosystem management are productivity, maintenance of biodiversity and protection from the effects of pollution and habitat degradation (Larkin, 1996; Jamieson et al., 2001; Sinclair et al., 2002; Canada, 2004; O'Boyle et al., 2004; Gavaris et al., 2005;). The implementation of these conservation objectives for Canadian fisheries was examined by DFO at a National Workshop "Objectives and Indicators for Ecosystem-based Management" (Jamieson et al., 2001).

It is evident that DFO has embraced this concept as the Fisheries Renewal initiative explicitly dedicates its policies to the issue of conservation. Likewise, the mandate of SARA is to prevent wildlife species from becoming extinct and to help the recovery of species that are at risk as a result of human activities. Furthermore, the Oceans Act states that it is of fundamental importance to promote conservation based on an ecosystem approach.

3.1.1 Productivity

Production of fished species ultimately depends on the fixation of carbon by marine plants and its transfer along the food chain (Jennings et al., 2001). Fish production results from fish growth (Jennings et al., 2003). To grow, a fish must feed effectively and convert food into tissue (Jennings et al., 2003). The production of fished species is highest in coastal shelf waters and upwelling areas, broadly reflecting the high levels of

primary production in those areas. Production is lower in the deep sea where fished species rely on carbon exported from shallow water (Jennings et al., 2003).

In order to maintain ecosystem productivity, it is necessary to maintain primary productivity, trophic structure and maintain population generation time (Jamieson et al., 2001; O'Boyle et al., 2004). The maintenance of species to their positions in the food web may be achieved by such measures as reducing harvesting to a level that will not alter the balance outside its natural variation; maintaining habitat availability including, spawning areas, nursery areas, migration pathways and foraging areas and ensuring predator-prey relationships remain. When looking at single species productivity, maintaining a large age structure, fish condition, and reproductive potential are some ways to maintain populations (Cochrane, 2002) within the bounds of natural variability.

3.1.2 Biodiversity

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems. It includes diversity within species, between species, and of ecosystems (Jamieson et al., 2001; Canada, 2004; O'Boyle et al., 2004). Species that are affected by fishing practices are connected in many ways such as predators, prey and competition (Jennings et al., 2001) and they rely on their ecosystems. FAO suggests some strategies to protect biodiversity are to reduce fishing pressure, rebuild depleted populations; reduce bycatch and improvement of survival of released species, protect endangered species, implement the precautionary approach and effective habitat management. Jamieson et al. (2001) and O'Boyle et al. (2004), suggest that to

conserve ecosystem components you must maintain communities (i.e. numbers of identified communities, rare and sensitive habitats), species (i.e. number of species in a location, species at risk) and populations (i.e. structure and genetic diversity among, and within populations).

3.1.3 Habitat

Habitat is the place or environment where a plant or animal naturally and normally lives and grows. FAO states that it is necessary to protect functional and critical habitats from fishing, land-based pollution and degradation. In all habitats, this should be applied to target and non-target species (Garcia et al., 2003B). Landscapes (bottomscapes), water column properties, water quality, and biota are necessary habitat characteristics to evaluate and maintain quality (Jamieson et al., 2001; O'Boyle et al., 2004). Essential fish habitat has been defined as those waters and substrate necessary for spawning, breeding, feeding or growth (Jennings et al., 2003).

3.2 Social and Economic Objectives

The human dimension is central to fisheries management because it is the behaviour of people that is managed not the behaviour of fish (Wilson and McCay, 2001). The many international instruments discussed in the previous section have stated that social and economic concerns need to be addressed in an EAF approach. All fisheries management decisions affect social and cultural groups and individuals in different ways (Wilson and McCay, 2001) and these effects should be considered and documented. Thus to successfully implement an EAF, the social and economic factors need to be better

understood, including the incentives or disincentives that drive human behaviour (De Young et al., 2008).

Even before the fuel price increase of 2008, the economic health of the world's marine fisheries were reported to have been in decline (World Bank, 2008; Willmann and Kelleher, 2010). Ignoring the economic and social health of fisheries are believed to result in a continued decline in global fish wealth, harvest operations that become increasingly inefficient, growing poverty in fishery-dependent communities, increased risks of fish stock collapses and compromised ecosystems (World Bank, 2008; Willmann and Kelleher, 2010).

Conventional indicators such as fishery gross domestic product and employment are commonly used as social indicators (Charles et al., 2009). Although these indicators can be very useful, there is a growing body of research that has called for, and given examples of more robust and appropriate indicators (Charles et al., 2009).

Historically, economic prosperity is one socio-economic objective that management systems have addressed (Jentoft et al., 1998; Canada, 2004). Economically healthy fisheries are fundamental to achieving common fisheries objectives such as improved livelihoods, food security, increased exports, and the restoration of fish stocks (World Bank, 2008; Willmann and Kelleher, 2010). Economic prosperity is the first economic objective offered in this report as a necessary objective for implementation of an EAF.

This objective needs to be developed (i.e. sub-objectives and indicators) to be more comprehensive and robust.

Two additionally important and related objectives that are necessary to incorporate into fisheries management, in order to achieve an EAF, are participatory management and viable communities. According to Charles (2008), World Bank (2008) and Willmann and Kelleher (2010) the empowerment of fishing communities is an essential tool to resolve the crisis in many marine fisheries.

3.2.1 Economic Prosperity

The economic performance of marine capture fisheries can be determined by the quantity of fish caught, the price the fish, the harvesting costs and the production of the material (World Bank, 2008; Willmann and Kelleher, 2010). A simple economic objective is to maximize the net profit from the fishery, essentially maximizing the difference between the landed value and the harvesting costs (Hilborn and Walters, 1992). Ecosystem-based management is a way to help achieve economic prosperity. Willmann and Kelleher (2010) and World Bank (2008) believe that increasing economic prosperity of fisheries should be a focus of fisheries management and will help to resolve the crisis in marine fisheries.

Since the late 1960's, Canada has placed considerable emphasis upon creating a more economically efficient fishing industry (Parsons, 1993). Despite numerous attempts to bring capacity more in line with available resources, excess capacity continues to be a

problem in many Canadian (Parsons, 1993) and international fisheries (World Bank, 2008). One of the important goals of the *Commercial Fisheries Licensing Policy for Eastern Canada* was to achieve a balance between harvesting capacity and resource availability. Although departmental policies intended to limit entry to the fisheries and harvesting capacity have had some success in achieving this balance, several fleets remain too large (Canada, 2004). Consequently, the long-term economic viability and the sustainability of those fisheries are in jeopardy. It is important to re-focus on the economic objective for fisheries to have self-reliant commercial harvesters that are able to adjust to fluctuations in resource abundance as well as in markets.

3.2.2 Participatory Management

Participatory management (or co-management) systems have existed in some fisheries for decades, in a few instances for centuries (Jentoft, 2003). For example, Vietnam has traditions and customary practices for fisheries co-management that have lasted for centuries (Pomeroy and Viswanathan, 2003).

Participatory management applied to fisheries occurs when government and resources users share the power and responsibility for management of a fishery (Pomeroy and Berkes, 1997; Jentoft, 2003). Jentoft (2003) defined it as a collaborative and participatory process of regulatory decision making between representatives of user groups, government agencies, research institutions and other stakeholders. Power sharing and partnership are the key elements of this definition. There is a plethora of literature on participatory management in fisheries demonstrating the many different ways of

implementation and factors that affect its successes and failures. The term covers a wide spectrum of power sharing arrangements from consultations with users to government having a purely advisory role (Figure 1) (Schreiber, 2001; Jennings et al., 2001).

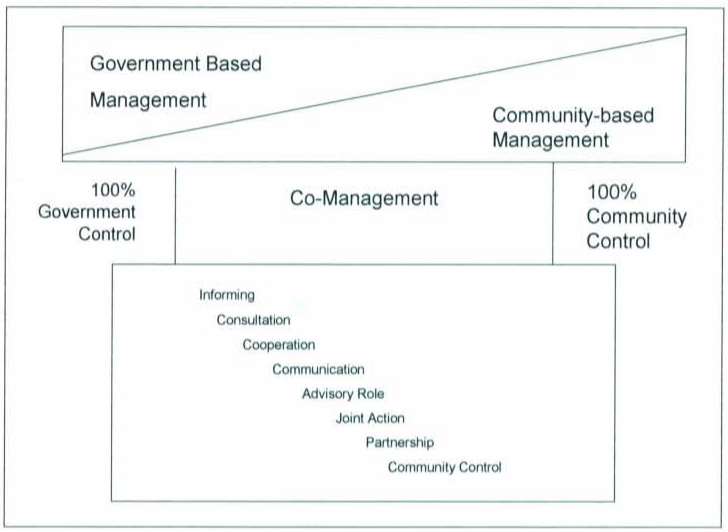

Figure 1: Co-management continuum (adapted from Ninnes (2004))

Depending on the situation, and the institutions that exist, each arrangement will be different. In order to be effective, Pinkerton (2002) emphasized that partnerships have to be carefully designed for the situation, as well as accountable. There is no standard formula on how to design such a system (Jentoft et al., 2003) and it is possible that a participatory management system may not work in all settings. However, to be successful, an adaptive and experimental approach was recommended by Jentoft (2003). Social science researchers of participatory management have published many papers on

the conditions that should be in place or exist to increase success. However, they cannot state with certainty which conditions are necessary in all circumstances (Pinkerton, 2002).

The key to any management system is to ensure cooperation and compliance to the regulations (Wilson and McCay, 2001). It is impossible to manage or regulate an unwilling industry (R. Stephenson, DFO, Personal Communication, June 29, 2005). Consequently, the legitimacy of fisheries management regimes, and hence their success depends on how various groups participate in the process (Wilson and McCay, 2001; De Young et al., 2008). When the communities and organizations of fishers are included as partners in the planning, design and implementation of regulations they grant full legitimacy to the regulations, and are the strongest advocates, monitors, enforcers and implementers of management decisions (Jentoft et al., 1998; Pinkerton, 2002; Wilson, 2003a; Wilson, 2003b Jentoft, 2003). The resource users become more knowledgeable and committed to regulations that they are a part of developing (Jentoft et al., 1998).

Ideally, participatory management encourages improvements in the resource, the resolution of conflicts in a timely manner and less reliance on expensive surveillance and enforcement (Pinkerton, 2002; Wilson, 2003b). Sharing the responsibility in regulatory decision-making is a step towards more ecologically and socially sound management (Jentoft et al., 1998; World Bank, 2008; Willmann and Kelleher, 2010).

3.2.3 Viable Communities

Well functioning communities are basic to all human endeavors, including fisheries (Jentoft et al., 1998). Although there are different definitions of communities, they all contain human, social and capital resources that should be put to use, and it is within the reach of public policy to provide the necessary conditions to keep communities sustainable and self-sufficient (Jentoft et al., 1998).

In Canada, the fishing industry is a vital source of employment and income to over ten thousand fishermen in more than one thousand coastal communities (Parsons, 1993). Almost 23 % of the countries population lives in coastal communities (DFO, 2003A). In many instances community survival is closely linked to the fate of the fishery in that region (Parsons, 1993). Fishing communities are part of the nation's social and cultural heritage (DFO, 2003A). Consequently, the residents and governments are concerned about the welfare and preservation of these communities (Parsons, 1993; DFO, 2003A).

Fisheries management decisions have important implications for the viability of both the fishing industry and their associated coastal communities. The number of jobs, the stability of those jobs, the incomes generated and the ability for a community to thrive are all affected by fisheries management decisions (Canada, 2004). Understanding the social impacts of various management choices would allow managers to choose the option that causes the least negative community impact (Fletcher, 2002).

Jentoft et al., (1998) points out that one way to achieve sustainability of coastal communities and empowerment of users is by the sharing and delegation of management authority. Choices in participatory management and human action can be driven from positions individuals hold as members of social groups, communities and organizations (Jentoft et al., 1998). Therefore decisions that are beneficial to groups, rather than individuals, will be chosen due to community judgments.

Viable fisheries communities require viable stocks (Jentoft, 2000). Fishermen are born and raised and live in communities; their fishing practices are guided by the values, norms and knowledge that are shared within their community (Jentoft, 2000). Well functioning communities are an important contribution to fisheries management. This can be accomplished through fisheries management and through policies that that aim at strengthening institutions at the community level (Jentoft, 2000). Overfishing can be seen as community failure (Jentoft, 2000). Over fishing occurs when fishers do not care about their resource, their communities and each other (Jentoft, 2000). Managers should therefore make decisions that reflect community wellbeing.

Viable communities should be a goal for government. A result of achieving this goal is economic efficiency, as there will be fewer payments in such areas as health care and family assistance. In addition, the community thrives and contributes more to the wellbeing of the nation.

4. 0 Frameworks for Ecosystem Approach to Fisheries Management

Management frameworks turn what have generally been philosophical concepts and overarching objectives into practical outcomes (Fletcher, 2006). They provide organization and structure for the management of a system or an institution. Generally, frameworks are a set of rules or norms governing the behaviour of individuals in a system of interacting ecological, economic, social and cultural components (Charles, 2001). The overall goal of a management framework is to ensure that the organization and all of its subsystems are working together efficiently to achieve the results desired by a group (Dumanski and Pieri, 2006).

4.1 Characteristics of a Successful Framework

A management framework for fisheries is necessary to address goals and issues in a coherent and logical manner and to incorporate the full set of ecological consequences of fishing (Garcia and Staples, 2000; Fletcher, 2006). A framework is an efficient way to ensure that the increasing objectives of fisheries management are being evaluated and addressed appropriately.

Fisheries around the world are managed with a broad range of institutional structures (Hilborn et al., 2005), and consequently, there is no universal design for a management framework (Pajak, 2000; Babcock and Pikitch, 2004; W.K. de la Mare, 2004). It is recognized that the development of a framework will depend on many factors (including economic, environmental, social circumstances, community values and judgments)

(MacLaren, 1996). Although there is no set structure for a framework, there is an increasing body of work dedicated to articulating what structural elements are necessary to ensure the success of management frameworks (Imperial 1999; Hilborn et al., 2005).

There are management frameworks developed for fisheries that draw upon other disciplines such as management science. The use of industrial control systems for marine ecosystem-based management was suggested by de la Mare (2004), Management Strategy Evaluation (or MSE) was proposed by Smith et al., (1999). Likewise, in papers written by Lane and Stephenson (1995, 1997) the use of management science, operational research and systems analysis were used for complex decision making and problem resolution in search of more holistic fisheries management regimes.

In addition to the frameworks previously mentioned, Garcia and Staples, (2000) and the FAO (1999) provided a comprehensive summary of the following frameworks that could be used for Ecosystem-based management (EBM):

- Code of Conduct for Responsible Fisheries
- FAO definition of sustainability
- General framework for sustainable development
- Pressure-State-Response (PSR) framework and aliases
- Ecological Sustainable Development (ESD) framework

Hilborn et al. (2005) completed an ad hoc review of several fisheries management systems around the world. They found that the primary determinants of success related to the right incentives, increasingly restrictive access, simpler institutions and appropriate management scales. In addition, they concluded that there is clearly a need for large scale quantification and evaluation of biological and economic successes and failures in fisheries management (Hilborn et al., 2005). Further, FAO (1999), Garcia and Staples (2000) and De Young et al (2008) found that effective ecosystem-based management requires active participation, proper incentives, increased transparency and systematic appraisal of performance. According to Garcia and Staples (2000), an effective fisheries management framework needs to meet the following criteria:

- Delivers meaningful information about the achievement of sustainable development and policy objectives (including their legal basis) at the desired scale
- Is inexpensive and simple to compile and use
- Optimizes the use of information
- Handles different levels of complexity and scales
- Facilitates integration and aggregation of indicators
- Provides information that is readily communicable to stakeholders and
- Can contribute directly to improved decision making processes

A symposium was held by the International Council for the Exploration of the Sea (ICES) in 1998, with the objective of examining procedures for decision making in fisheries management (Stokes et al., 1999). The symposium concluded that, *inter alia*, fisheries

management objectives need to be clearly articulated by all stakeholders; formal evaluation of the systems performance is essential; and there is a need for objectives to be consistent with international fisheries conventions and standards (Stokes et al., 1999).

The following list is a compilation of the characteristics or structural objectives that I believe are the minimum necessary in order to meet legal obligations in implementing an EAF (Figure 2). These are often recommended for the successful implementation of any management framework. This list has drawn upon a wide range of published literature. These objectives were chosen in the context of current management practices in Canada and the established conservation objectives together with the social economic objectives offered in this paper (Section 3). The full suite of objectives (conservation, social, economic and structural) is analyzed in the following case study.

These structural objectives can be interrelated and overlap; their boundaries are not always clear. For example, industry participation is not a characteristic listed here, however it is a specific management objective in section 3 and is explicitly part of the increased transparency and communication objective. Also, increased transparency and communication is implicitly part of all the other objectives, for example prioritization could not happen without stakeholder participation. At a minimum, successful implementation of an ecosystem approach requires:

i. using indicators, references points and decision rules
ii. prioritization

iii. being inexpensive and simple to use

iv. increase transparency and communication

v. evaluation of progress

vi. measurement of the cumulative effects from all ocean uses

Using indicators, references points and decision rules:

Although a standardized framework has not yet been developed, an emerging trend is the use of indicators as a tool in management system (FAO, 1999; Potts, 2006; Garcia, 2010). Frameworks can be used to organize, evaluate and map indicators (FAO, 1999; Potts, 2006) and there is a considerable amount of literature dedicated to the establishment of different indicator systems. Several authors demonstrated that many single species management plans are successfully being re-evaluated in the context of ecosystem objectives by incorporating an indicator system to assess progress (FAO, 1999; Sainsbury and Sumaila, 2001; Potts, 2006; Garcia, 2010). Indicator systems provide a means to evaluate progress toward meeting established objectives, and are necessary to be effective.

Prioritization:

Implementing the expanded objectives, mentioned in section three, will result in an increased number of issues identified with varying degrees of importance (Fletcher et al., 2002; Gavaris 2005; Garcia, 2010). Given the likelihood that there will likely not be enough human or financial resources available to address all the issues, a risk assessment, or triage, is necessary in order to determine which impacts should be looked at first

(Fletcher et al., 2002; Stephenson and Gavaris, Presentation 2006; Gavaris 2005; Garcia, 2010). Additionally, prioritization should happen within a participatory management context.

Inexpensive and simple to use:

Implementing an EAF should be as inexpensive and simple to use as possible in order to be successful. A benefit of starting from established management plans to implement an EAF, is that they are inherently simpler to use (Gavaris, 2005; Garcia, 2010). Simpler processes (Hilborn et al., 2003; Bianchi, 2008; Garcia, 2010) are believed to help in achieving a successful fisheries framework. It is also more cost effective to start from existing plans, as there is no time spent learning a whole new system. It also increases legitimacy of the process because the management is building upon shared experience and a management plan that they have helped develop (Garcia and Staples, 2000).

Increase transparency and communication:

Many of the international instruments mentioned in section two require that stakeholders be more closely associated to the management process, in data collection, knowledge-building, option analysis, decision-making and implementation. A method to reach this goal is to increase transparency and communication. Increased transparency and communication have been demonstrated to help achieve a successful fisheries framework (FAO, 1999; Garcia and Staples, 2000; Hilborn et al., 2005; Bianchi, 2008).

Evaluation of progress:

Evaluation of progress made towards stated objectives and of the management framework as a whole is also necessary (Stokes et al., 1999; FAO, 1999; Potts, 2006; Garcia, 2010). FAO (1999), Garcia and Staples (2000) and Bianchi (2008) are a few of the authors that have found that effective EAF requires systematic appraisal of performance.

Measurement of the cumulative effects from all ocean uses:

Another emerging consensus is the need for the measurement of the cumulative effects on the ecosystem from all ocean uses (Gavaris et al., 2005; and Gavaris, 2008; Bianchi 2008). Bianchi (2008) describes that in order to be a true EAF, a cross-sectoral approach to ocean management is required. From a Canadian perspective, the management of the cumulative effects of ocean uses is a legal requirement from the Oceans Act, which has not been fully met.

If these structural objectives are part of a framework with the expanded conservation, social and economic objectives it would insure a comprehensive framework for the implementation of an EAF in Canada. Consequently, legal obligations both nationally and internationally would be met.

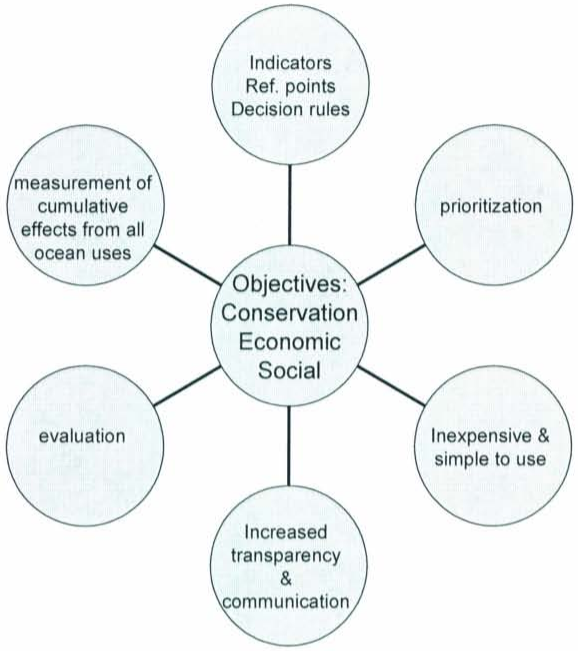

Figure 2: Proposed structural objectives for successful implementation of EAF.

Canadian authors S. Gavaris, J. Porter, R. Stephenson and D. Pezzack first published a framework for ecosystem-based fisheries management in 2005 (referred to here as the 'Canadian Approach'). Further developments of the framework have taken place over the last five years and it is being implemented in all the major fisheries of DFO Maritimes Region on the east coast of Canada. Australian authors W.J. Fletcher, J. Chesson, M. Fisher, K. Sainsbury, T. Hundloe, A. Smith and B. Whitworth first published their main document in a framework for ecosystem-based management in 2002 (referred to as the

'ESD Approach'). Similarly, this framework has been implemented in Australian fisheries.

These two frameworks are compared here. The Canadian Approach was a logical choice because it is the approach that is currently being used in the Maritimes Region and as a result inherently less complicated for the people involved, has already developed from experience, is simple (because of that experience) and consequently more economically efficient. The ESD Approach was chosen because it has gained the attention of FAO, and was the foundation on which the FAO approach to EAF was developed (Bianchi, 2008). Moreover, the similarities in the development of national policies and legislation in an attempt to implement international instruments between Australia and Canada have been evaluated in a paper by Haward et al., (2003). In this paper it was noted that both Canada and Australia had a large rural and cultural dependence on fisheries due to both having large coast lines.

4.2 Canadian Approach (2005): Fisheries and Oceans, Maritimes Region

The Canadian Approach put forward a practical ecosystem-based framework that has been adopted and implemented by the Maritimes Region of DFO. It explicitly recognized that the three essential objectives of conservation are maintaining productivity, preserving biodiversity and protecting habitat. Central to this approach is ensuring that the management of human activities are consistent with the goals of maintaining appropriate temporal and special scale of marine ecosystems (Stephenson and Gavaris, Presentation 2006). This is accomplished by applying the ecosystem-based framework to all managed

current management plans are being re-evaluated in the context of ecosystem objectives as stated by FAO (1999); Sainsbury and Sumaila (2001); Potts (2006) Garcia, 2010.

In Atlantic Canada, not all fisheries management plans are structured in the same manner. Application of this approach to every fishery would promote consistency, an important element to ensure that fisheries are meeting all the necessary requirements and promotes simplicity between fisheries. In addition, it could be applied to other resource use activities through an integrated management context; a truly ecosystem-based approach to management of ocean resources requires consideration of multiple human activities (i.e.: aquaculture, energy, recreation and tourism) (Gavaris et al., 2005) and the measurement of the cumulative effects of human activities on a particular ecosystem.

In conclusion, this approach meets the conservation requirements of an ecosystem-based management approach and it is argued that all of the structural criteria are met as well. However, the social and economic requirements are yet to be developed in this approach.

4.3 The Australian National Ecological Sustainable Development (ESD) Reporting Framework for Australian Fisheries (2002)

Since 1992, the pursuit of ecologically sustainable development has been increasingly incorporated into the policies and programs as a significant policy objective of the Australian government (Australian Government, 2007). The National Strategy for Ecological Sustainable Development was adopted by all levels of Australian government in 1992. Three key objectives of this strategy were agreed to at that time and included: 1)

to enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations 2) To provide for equity within and between generations and 3) to protect biological diversity and maintain essential ecological processes and life support systems (Fletcher et al., 2002). A reporting framework to work towards EBM for fisheries in Australia was developed.

The ESD reporting framework is about how to detail all the things a fishery does and with what it interacts (Fletcher et al., 2002). It is meant to include both positive and negative interactions (Fletcher et al., 2002). The framework requires documentation of what the fishery intends to do in the future and how it will measure whether it is achieving the goals that have been set (Fletcher et al., 2002).

This approach is fundamentally about its implementation focused on consultation to identify priorities in a risk framework. The framework consists of four steps. The first step is to identify the issues through a given structure. The second step is to complete a risk assessment on each of the issues. A performance report and a compilation of background materials are the third and fourth steps respectively.

Fletcher et al., (2002) described the benefits of this type of report as

- an excellent compilation of information on each fishery that is of great value to management agency, turnover of staff, researchers.
- documentation of specific objectives and performance measures for all stakeholders
- potentially helpful in exporting criteria

- useful with some forms of environmental accreditation such as the MSC
- and useful to marine planning and coastal zone management.

The identification of issues, step one, is accomplished by using "component trees" (Figure 5). Each component tree is generally at too high a level to develop sensible operational objectives for an individual fishery (Fletcher et al., 2002). Consequently, each of these components needs to be "delineated" to become operational (Fletcher et al., 2002). The generic trees are used as a starting point for each assessment and are subsequently adapted for each fishery using an open consultative process involving all relevant stakeholders (Fletcher et al., 2002). Utilizing the component trees often results in a large number of issues identified, the importance of which varies greatly (Fletcher et al., 2002). There are eight major components or trees. They are 1) retained species, 2) non-retained species, 3) general ecosystem, 4) indigenous well being, 5) community and regional well being , 6) national social and economic well being, 7) impacts of the environment on the fishery; and 8) governance arrangements.

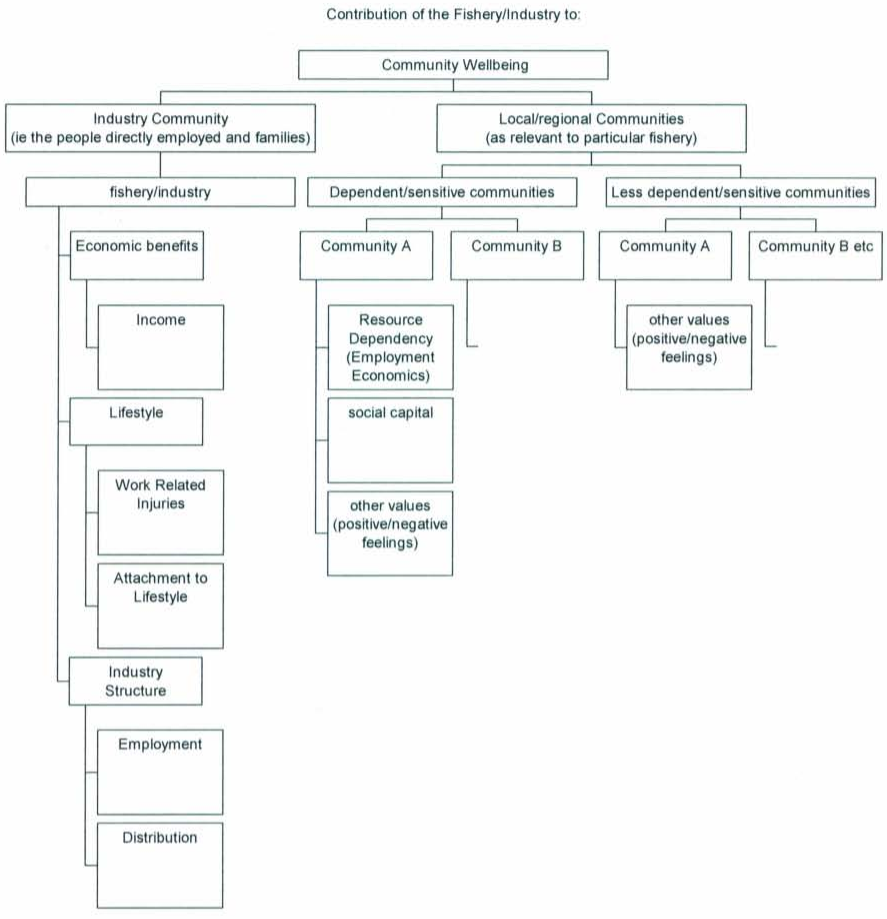

Figure 5: One of the eight Component Trees from the ESD approach http://www.fisheries-esd.com/c/implement/implement0200.cfm .

Risk assessment methodology is used to prioritize issues in order to determine the appropriate level of management (Fletcher et al., 2002). The methods are explained in the detailed document entitled *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide For wild Capture Fisheries.* To be managed effectively, issues need to be identified at a level that will allow the development of sensible operational

objectives and indicators so that performance can be appropriately evaluated (Fletcher et al., 2002).

The performance report section is where justification of current management actions (or inactions) is to be provided. The report details how to measure whether management actions are achieving the goals that have been set. Where specific management action is not necessary, the report needs to justify the conclusion. Likewise, when management actions are taken a full performance report is needed, and justifications of the decisions are to be detailed. Performance reports analyzing information in nine pre-determined subject areas (Appendix 1).

The final step is the background information section. It is meant to include the history of the fishery, gear used, main species, general information on habitat biology, etc. It should also include the social, economical and political environments in which the fishery operates.

In conclusion, the ESD reporting framework meets the conservation requirements of an ecosystem-based management approach as it explicitly addresses productivity, habitat and biodiversity. Most of the structural objectives are met as well. The measurement of cumulative effects is an implicit goal (Australian Government, 2007). The social and economic requirements are well developed in this approach.

4.4 Comparative Analysis of Two Approaches

Both the Canadian Approach and the Australian Approach are considered to be functional ecosystem-based management frameworks. Their structure and content were evaluated from the perspective of what this report concluded to be required for an ecosystem approach. The Canadian Approach was developed by Gavaris et al., (2005) and was chosen because it is an evolution of the management framework currently in place in the Maritimes Region of DFO. It is a framework that is considered evolutionary rather that revolutionary (Gavaris et al., 2005) and therefore is naturally simpler to use (one of the criteria for a successful framework). The second approach considered was the Australian Approach. It was chosen because it was the most developed, comprehensive and easy to follow.

There are many similarities between these two frameworks. Both of the frameworks were found to meet the essential criteria set out in this document and therefore are considered ecosystem approaches to fisheries management. They both begin with the fishery as the reporting unit and they have both clearly articulated that expanded conservation objectives are needed for an ecosystem approach. As a result of the expanded objectives, many more issues are anticipated to be identified. Consequently, both approaches require a risk assessment in order to balance financial resources with demand of what progress needs to be made. Finally, they both promote a level of consistency for all fisheries and for cumulative effects to be measured across resource uses in one area.

The most obvious difference between the frameworks is the level to which they are developed. The Australian government has made it part of their mandate to develop more environmentally friendly attitudes, and as a result, the resources and political will to fully develop an ecosystem approach were available. The indicator system, the social and economic objectives and the level of documentation required are all more developed in the Australian approach. It was beyond the scope of the Canadian Approach project.

Both of these frameworks require the use of indicators and reference points. As previously discussed, this is a common element in many frameworks that have been developed for ecosystem-based management. The Australian Approach goes one step further and requires that decision rules be developed. In Canada, The Precautionary Approach, is a policy which requires a similar system to be set up for existing fisheries, however, this is only implemented in a handful of fisheries. Also, if the corrective action is already determined, it is unlikely that industry will protest as they will have had prior knowledge. Unlike Canada, the Australian ESD approach requires justification of all management decisions be included in the report.

The development and use of social and economic objectives are developed and documented in the Australian Approach (2002), but they are not detailed in the Canadian Approach. The Australian Approach has a detailed supporting document on how to consider social and economic aspects for fisheries management.

The level of consultation that was completed in the development of the frameworks appears to be different. The Australian Approach documents extensive consultation in the development of their approach and requires extensive consultation in the implementation of the framework. Although the Canadian Approach does not document such a level of consultation in either the development or implementation of their approach, implicit in their current Integrated Fisheries Management Plan (IFMP) and the framework is a high level of participatory management. This is evident in the requirement to have advisory committee and industry roundtable meetings. The two frameworks also differ in the amount of consultation they require in the implementation stage. This is likely a factor of the level of development of the two approaches and that the Canadian Approach is focused primarily on the conservation objectives. Another major difference is that the Canadian Approach focuses on managed human activity. As a result, the implementation is meant to focus directly on what human activities can be managed to realize established ecosystem objectives.

Another similarity between these two approaches is that they include the same criteria that previous authors have suggested are necessary in order to have a successful ecosystem approach (i.e. indicator system). The Australian approach is much more developed and could be used to guide further development of the Canadian Approach. Where the Australian Approach falls short is that implementation of such an approach needs to reflect that it is human activity that is managed.

5.0 Case Study: The Grand Manan, New Brunswick Groundfish Gillnet Fishery: does the management plan contain the required elements of an EAF?

The following evaluation of the existing management regime for the Grand Manan groundfish gillnet fishery was intended to establish 1) does the current management plan have the required elements of an EAF, and if so 2) is the plan successful at meeting an EAF. It is important for fishery managers to reflect upon or evaluate the management plan in place for a particular fishery to determine if it has met the international and national obligations for implementing an EAF. The evaluation in this work was completed by determining if the current management documents have the required elements as described in this paper, or if not, in what areas it needs to improve.

The expanded objectives in section 3.0 and structural objectives in section 4.0 (Table 1, Figure 2) were used to evaluate the current management regime. A relatively small fishery was chosen. This fishery is governed under the Maritimes Region IFMP for Groundfish. The fishery is a smaller portion of a much larger fishery. A comprehensive background summary was developed for context. Since this was evaluated against an expanded framework, the additional objectives are not likely part of the current Groundfish IFMP. This evaluation was not completed within a participatory management context, although the background section was reviewed by the Grand Manan Fishermen's Association to ensure accuracy. This audit was not an attempt to write a new management plan according to the prescribed method outlined above. The purpose was to evaluate and audit to what degree the current plan is implementing an EAF.

Table 1: EAF summary of management objectives

Conservation Objectives	Social and Economic Objectives	Structural Objectives
Productivity	Economic Prosperity	Indicator / reference points and decision rules
Biodiversity	Participatory Management	Prioritization
Habitat	Viable Communities	Inexpensive and Simple
		Increased transparency and communication
		Evaluation of progress
		Measurement of cumulative effects

5.1 Background

The Grand Manan groundfish gillnet fishery takes place in the Bay of Fundy portion of the Scotia-Fundy region in the waters surrounding Grand Manan Island (Figure 6) (Trippel and Shephard, 2004). This is a small domestic fishery of less than 20 vessels that are typically 11 – 14 meters in length (Trippel et al., 1999). Atlantic cod and pollock are the species targeted and are generally taken in the summer months of July and August (Trippel and Shepherd, 2004).

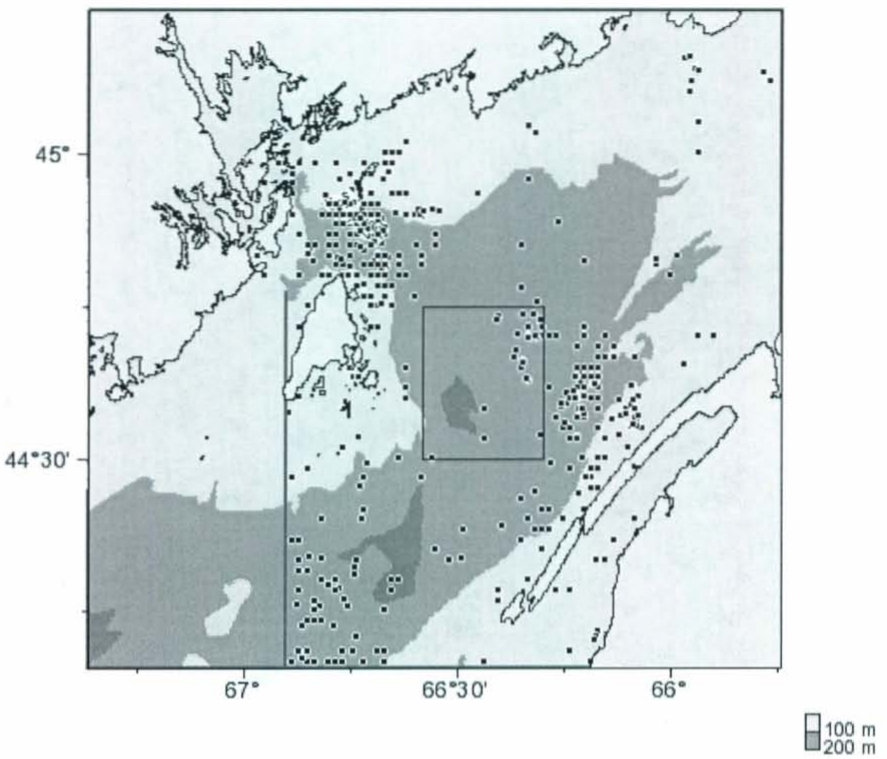

Figure 6: Location of Sets of the Grand Manan gillnet fishery from 1986 – 2003. The Right whale conservation Zone located close to Grand Manan is shown.

The licence holders on Grand Manan work from three community harbours: North Head, Ingalls Head, and Seal Cove (Richter, 1998). Areas suitable for setting groundfish nets are limited in the lower Bay of Fundy, resulting in high concentrations of gillnets in small areas (Trippel et al., 1999). Examples of the most popular fishing grounds are the Grand Manan Banks, Head and Horns, Head Harbour, The Channel, Grand Manan Basin,

Swallowtail, the Wolves and Northeast Bank (Richter, 1998; Hood, 2001; Trippel and Shepard, 2004).

Fishermen have been using gillnets to fish for groundfish commercially in the Gulf of Maine area for over a century (Collins, 1886). However, it was not until 1976 that the Grand Manan groundfish fleet started using gillnets to prosecute this fishery; prior to this the fleet used hook and line gear or bottom trawls (Clark, 2004 Personal Comm.). Gillnetting is made of monofilament nylon with a mesh size of 6 inches (Richter, 1998). During peak times, fishers can typically make 4-5 trips per week and set 4-6 strings of gillnet per trip (DFO, 1996; Richter, 1998; Trippel et al., 1999; Hood, 2001). Each string is generally comprised of 3 webs (Hood, 2001); each web is approximately 100 m in length and 3 m in height (DFO, 1996). Researchers that have previously studied this fishery reported that the average soak time for nets was between 16-48 hours and ranged from 1.8 – 102.3 hours (Richter, 1998; Trippel et al., 1999; Hood, 2001). Gillnets in waters adjacent to Grand Manan Island were set at depths with an average of approximately 100 m. in 1994 and 1995 (Hood, 2001).

Landings were dramatically reduced in the early 1990s due to restrictive management measures and have remained low. In the 1980s pollock dominated the catch; however, in the early part of this decade, cod dominated the catch. The number of active participants and the total number of trips have declined (Trippel and Shepherd, 2004). The number of active vessels participating decreased from 22 in 1998 to 13 in 2001 (Trippel and Shepherd, 2004).

Although cod and pollock are the species that licence holders direct for, many other species are caught as incidental catch or bycatch. Herring, dogfish, white hake, various flat fish, harbour porpoise and greater shearwaters are among the species that have been reported to be incidentally caught in this fishery (Richter, 1998; E. Trippel, DFO, Personal Communication, October 15, 2004). Acoustic pingers have been employed in this fishery to reduce harbour porpoise bycatch.

Generally, the licence holders for this fishery participate in other fisheries throughout the year. The majority of licence holders also participate in the lobster fishery in the spring and fall while their summers are spent gillnetting (E. Trippel, DFO, Personal Communication, October 15, 2004). Licence holders from Grand Manan are dependent on groundfish revenues and could not sustain their enterprises without the income from this fishery (Richter, 1998).

The Grand Manan Gillnet fishery is a small part of the Southwest Nova Scotia / Bay of Fundy groundfish fishery and is governed by four documents and Conditions of Licence in addition to the various legislative requirements that were covered in Section 2.0. These governing documents are the Scotia-Fundy Groundfish Integrated Management Plan, the Conservation Harvesting Plan Fixed Gear <45' 4VWX+5 (an annex of the management plan), the Harbour Porpoise Conservation Strategy, and the SWNB Fixed Gear Groundfish Board Conservation Harvesting Plan. This final document was written by the industry. The specific tactics to achieve the objectives for this fishery are found in the

SWNB Fixed Gear Groundfish Board Conservation Harvesting Plan and the Conservation Harvesting Plan Fixed Gear <45' 4VWX+5. In addition, the Harbour Porpoise Conservation Strategy sets limits on the incidental catch of harbour porpoise for this fishery (DFO, 1995). From this point forward all the documents with the exception of the Harbour Porpoise Conservation Plan will be referred to as the IFMP.

There are three overarching objectives for the groundfish IFMP as written in the plan. These are articulated into the general objectives of conservation of resource productivity, by managing the groundfish resource in a manner consistent with legal obligations and treaties and finally by creating a regime in the spirit of co-management. Sub-objectives are provided to complete the statements. Appendix 2 contains a table reproduced from this plan (Canada, 2002C). It describes how the objectives are to be achieved by using strategies. Tactics are the specific actions that are to be taken within a given strategy. There are no indicators developed or reference points to evaluate progress. The IFMP stated that one of the first tasks to be completed in improving the plan was to develop indicators and reference points. Decision rules are only developed in the CHPs to ensure licence holders stay within the rules stated in the plan.

The conservation objectives for the fishery focus on the ecosystem and productivity. These objectives are relatively highly developed in the IFMP. There are five sub-objectives under the conservation heading. They are maintaining 1) community diversity (with respect to benthic communities); 2) species diversity, 3) population diversity, 4)

trophic structure, and 5) maintaining productivity of populations (by managing exploitation of target species).

The social and economic objectives are stated as 1) meeting aboriginal treaty rights, 2) making provisions for recreational fishing and 3) creating conditions for the economic self reliance in the commercial fishery. These are less developed than the set of conservation objectives.

A third objective of co-management is presented and moves directly to three strategies. In order to meet the general objective of instituting co-management, the plan states that it will implement the code of conduct, undertake co-operative DFO and Industry projects and build the industry management capacity. The tactics to articulate how these will be achieved were not developed in the plan.

Conservation Harvesting Plan - Fixed Gear <45' 4VWX+5

The specific management measures (other than catch quotas) that apply in any particular year are documented in fleet-specific Conservation Harvesting Plans (Canada, 2002C). The Conservation Harvesting Plan for Fixed Gear <45' in the 4VWX and 5 area has an annual allocation assigned to the fleet. The allocations are then distributed via community quota groups. This document included a copy of the license conditions, bycatch provisions, the small fish protocol, the monitoring rules and any closed areas.

Southwest New Brunswick (SWNB) Fixed Gear Groundfish Board Conservation Harvesting Plan

The industry is allocated a share of the TAC. This document included weekly trip limits, rules for the dockside monitoring program, bycatch regulations and penalties for violations. Essentially, this documents details industry derived decision rules and penalties for not staying within the TAC.

Harbour Porpoise Conservation Strategy for the Bay of Fundy

Written in 1995, the Harbour porpoise conservation strategy was developed with the intention to reduce the incidental capture of Harbour porpoise by fishing operations. The document only imposes one management measure that the incidental mortality cannot exceed 110 animals. There has been sporadic observer coverage, making the enforcement of this rule problematic. Now fourteen years old, many of the plans and strategies set out in the harbour porpoise conservation strategy should be re-evaluated as it is out of date.

Resource Status

Fisheries and Oceans Canada assess the overall health and state of the resource for the main commercial species every year during the Regional Advisory Process in consultation with the industry. A document called the Science Advisory Report (SAR) is produced from this process. Several indicators and indices (including, among others, independent scientific surveys, industry surveys and biological samples) are used to evaluate the resource health. Other species have different time lines for example, every two years or every five years. Generally, non-commercial species are not evaluated.

As stated in the groundfish IFMP, there appears to have been a widespread reduction in the productivity of demersal fish species on the Scotian Shelf and Bay of Fundy (DFO, 2000). Many of these species are also showing the onset of sexual maturity at smaller sizes (DFO, 2003B). In a single species context this implies a significant loss in potential yield relative to historical catches. In more recent assessments, it was confirmed that several commercially fished species in the area have shown long-term declining trends and are near the lowest levels observed in the research vessel survey series, while survey catches of halibut, winter flounder, pollock and redfish have all increased in recent years, with some at the highest level in the survey series (DFO, 2009B).

Cod

The 2004 SAR for cod stated that the 4X cod abundance had not increased since 1999 (DFO, 2004B). The landings for 2004 were the lowest on record at 5600t. Distribution indicators of local density and area occupied have declined and were considered low for 4X cod (DFO, 2002). Abundance indicators gave mixed messages to assessment scientists (DFO 2002).

Fixed gear fishermen in the Bay of Fundy indicated that cod abundance had increased but there is little increase in haddock where they fished (DFO, 2002). Since 2000, the industry has raised concern about the great difficulty of remaining within their quota for cod while pursuing other species (DFO, 2002). This is to be expected when there is a

multi species fishery where a restrictive quota exists. As a consequence, licence holders have reported that cod are being discarded and landed unreported.

The COSEWIC assessed four populations of Atlantic cod in May 2003, giving them a designation of 'Special Concern'. The rationale for this designation provided by COSEWIC was that the assemblage of stocks was at low levels of abundance as a group (COSEWIC, 2003A). Overall, cod populations in the entire region declined 14% in the past 30 years, and have demonstrated sensitivity to human activities. Threats to persistence included directed fishing, bycatch in other fisheries, illegal fishing, misreporting, discarding, natural predation, and natural and fishing-induced changes to the ecosystem (COSEWIC, 2003A). All are considered potential factors responsible for the lack of recovery of cod.

Pollock

DFO's scientific advice for pollock stated that several factors indicated a conservative harvesting strategy was appropriate for this region (DFO, 2004C). Estimates of biomass declined from about 60, 000t in 1984 to a low of about 10, 000t in 1999. They had then doubled to 20,000t in 2004 (DFO, 2004C). Fishery independent survey biomass estimates declined from the early 1980's to a low in 2000. Although they have subsequently increased, they remained lower than the 1980's (DFO, 2004C).

Canadian landings of pollock peaked at 45000t in 1987; then they sharply decreased, and in recent years have been less than 10 000t (Neilson et al., 2004). Estimates of fishing

mortality steadily increased from the early 1980's despite decreased landings, and were above the established reference point (DFO, 2004C).

Bycaught species

In the groundfish fishery, all species that are considered groundfish must be retained. Using unpublished data from DFO for the years 1986 - 2003 inclusive, the main bycaught species by weight were herring, large pelagics and spiny dogfish.

Spiny dogfish exhibit slow growth, relatively low reproductive capacity, long gestation period, and are relatively easy to capture (NOAA, 2003). Although there is an annual decision process there is no annual scientific assessment on stock status. Dogfish are classified as over fished in the USA (NOAA, 2003).

5.2 Analysis

Management of the Grand Manan gillnet fishery was evaluated against the three conservation objectives (productivity, biodiversity and habitat) communicated in this work and in Gavaris et al. (2005) as well as the social, economic and structural objectives established in sections 3.0 and 4.0. The purpose of the evaluation was to determine how well or to what degree the Grand Manan gillnet fishery was meeting the requirements of an EAF, as established in this paper. This evaluation was completed using the management documents that were summarized and collectively termed the IFMP in this paper.

5.2.1 Productivity

As outlined in section 3.1.1, under the expanded objective of productivity there are three sub-objectives. They address the effects of fishing activities on primary productivity, community productivity and population productivity.

Within the current IFMP both the primary productivity and the community productivity were considered to be 'conceptual objectives' and management was based within that context (Canada, 2002C). At that time, this fishery was not considered to have any direct effects on primary production through alteration of the available nutrients. Conceptually, the community productivity sub-objective focused on trophic energy flow through the community of species that exist in any one area. However, the level of research in this area at that time was considered insufficient to base any decisions (Canada, 2002C).

The hypothesis that this fishery has no direct affects on the primary production is still valid. Moreover, given the small size of the fleet and the fact that fishing effort is negligible, the Grand Manan gillnet fishery is not likely to have a significant affect on community productivity. Research in this area has grown significantly (Cook and Bundy, 2010) since the IFMP was written and therefore it is recommended that this is an area for further development in order to meet an EAF.

The IFMP for this fishery, as one would expect, is focused heavily on the sub-objective of population productivity. Strategies for conserving population productivity are primarily controlled by regulating the harvest using output and input controls. All of the operational

strategies to conserve population productivity are addressed in the current IFMP and are considered to be applied at the Grand Manan Gillnet Fishery level as well. It is difficult to determine if this particular IFMP is effective at meeting this sub-objective because there is no published data on such a small segment of the groundfish fishery. However, in this paper some general observations are made.

Although the effort of the Grand Manan gillnet fleet is so small that it could be considered to be successful in applying the operational strategies, the same can not be said of the groundfish fishery as a whole, even though there are several tools in place such as a small fish protocol and spawning area closures that would limit the removals of groundfish.

One of the productivity related objectives for this fishery, as stated in the IFMP, is to ensure that the activity does not cause unacceptable reduction in the productivity of each component so that it can play its historical role in the functioning of the ecosystem. This is to be achieved by using such operational strategies as keeping exploitation moderate and promoting rebuilding when biomass is low. The fact that the Atlantic cod was re-assessed in 2010 by COSEWIC as endangered from a previous listing of special concern indicates that the IFMP is not effective at ensuring that fishing activity does not cause an unacceptable reduction in population productivity. Moreover, although the pollock resource has been rebuilding since 2000 (DFO, 2009C), it is still at a relatively low level. Both of these species are the primary directed species in the Grand Manan Gillnet fishery.

5.2.2 Biodiversity

Under the expanded biodiversity objective, it is necessary to ensure that fishing activity does not cause unacceptable reduction in biodiversity by maintaining enough biotypes/seascapes, species and populations to preserve the ecosystem within its natural variability (Gavaris et al. 2005). There are four operational strategies for this expanded objective. The current IFMP addressed only one of these.

The seascapes/biotype operational strategy is not addressed in the current IFMP. As previously stated, there is an overlap between this sub-objective and a sub-objective in the next section where habitats are considered. There has been relatively little work completed on the identification of seascapes in the Grand Manan area, therefore there is not enough information to determine what affect that fishing has on the biodiversity or on the habitat of biotypes or seascapes in the area. Therefore it was not considered further.

The expanded operational strategy of limiting the impact of invasive species is not addressed in the current IFMP. Although it is not covered, the Grand Manan Gillnet fishery was considered to be effective in achieving this objective because this fishery takes place in such a small geographic scale and in a small area. The likelihood that this fishery would come in contact with or introduce an invasive species is negligible. Fishing operations happen over a small geographic area, and do not hold live animals (eliminating the need to move large quantities of water). Moreover, of the invasive species that already exist in the area, it is unlikely that this specific fishery would encourage further spreading due to the nature of the gear. These gillnets are anchored to the bottom and

therefore experience limited movement. They are then harvested in the same area and then set again.

The operational strategy of fishing not causing unacceptable reduction in population sub-structure is the third sub-objective that is not covered in the current IFMP. There is no published data on the population sub-structure of any of the directed species, with the exception, perhaps, of cod. Cod stocks in the whole management unit comprise a stock complex. The degree of mixing amongst components is too great to resolve them into separate assessment units (Clark and Emberley, 2009). Given the small geographic scale of the Grand Manan fishery, it is unlikely that the low amount of effort exerted would pose a risk to any population sub-structure.

This fishery is known to catch other species in addition to the two directed species of cod and pollock. The current IFMP does address the operational strategy of fishing not causing unacceptable reduction in the biodiversity of species (i.e. limiting incidental mortality) in various ways. Moreover, the IFMP also stated that this issue needed to be developed further (Canada, 2002C). There is no published, quantative analysis completed of the amount and type of species except harbour porpoise. Consequently, it is impossible to determine if the plan is effective at addressing this issue.

Using unpublished data from DFO for the years 1986 - 2003 inclusive, the main bycaught species by weight were herring, large pelagics and spiny dogfish. Seabird catch is also known to occur (E. Trippel, DFO, Personal Communication, October 15, 2004). More

recently, DFO has targeted the inshore groundfish fishery for a specific bycatch project. The purpose if this project is to quantify the amount of type of bycatch that is occurring. This project was the result of concerns that have been raised regarding bycatch.

The harbour porpoise conservation strategy is the best example where the issue of bycatch has been addressed. It provided details of management measures (i.e. time area closures) if harbour porpoise bycatch becomes an issue. In addition, there are caps on the amount of any non-directed for species that any licence holder may retain in the CHP piece of the IFMP. SARA listed species are the exception to this, they are required to be released through licence conditions.

There is one controversial factor related to this operational strategy that is not addressed in the IFMP, the threat of right whale entanglement in the fishing gear (Figure 6). Although the IFMP stated that groundfish gear is not a major source of right whale mortality and concluded that no further provisions were required under the plan (Canada, 2002C), this has subsequently been proven invalid. The spatial and temporal overlap of amount of gear and the distribution of right whales was studied by Johnston et al. (2007). The paper identified the Grand Manan groundfish gillnet fishery as one of two fisheries that likely pose the greatest risk for right whale entanglements. It was documented that there was a concentration of effort in the right whale Conservation Zone by this fleet during the months of June and October, at a time when the highest densities of right whales occur.

5.2.3 Habitat

A habitat is defined as the place where a particular organism usually lives or grows (Gavaris et al., 2005). The three sub-objectives for this expanded objective are to ensure that fishing activity does not cause an unacceptable modification of the bottom habitat, the water column or to biotype/seascapes.

A biotype is the smallest possible geographic region of a habitat (Gavaris et al., 2005). There is an overlap between this and in the previous section where biodiversity of habitats are considered. The biotype objective was not considered in the current IFMP. Moreover, there has been relatively little work completed on the identification of biotypes in the Grand Manan area, therefore there is not enough information to determine what effect that fishing has on the biotypes or seascapes of the area.

The bottom habitat sub-objective has not been thoroughly addressed by the current IFMP. The IFMP stated that research into this issue has just started and further objectives and reference points would be developed (Canada, 2002C). The Grand Manan fishery utilizes gillnets. Gillnets are known to cause minimal damage to the bottom, however, they are generally considered to have a relatively low impact compared to other gear types such as otter trawls. Moreover, the amount of gear being used in this fishery is nominal, and as a result the IFMP is considered to be effective at meeting an EAF for this sub-objective. For the whole Scotia-Fundy groundfish fishery there are coral area and a Marine Protected area closures that protect bottom habitat. In addition, progress can be seen in

achieving this objective through the Fisheries Renewal effort, which released the Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas.

Water column habitat is not addressed in the main IFMP document, however it is partially addressed in the CHP for the Grand Manan fixed gear community group. This is addressed by prohibiting nets being left unattended in some areas, which helps to reduce the incidence of lost nets. Moreover, anthropogenic noise is not addressed in the current IFMP.

The loss of nets and ghost fishing is known to occur in gillnet fisheries. There was a study completed in nearby Jeffries Ledge that quantified the amount of lost gear and provided an estimate of mortality due to ghost fishing (Cooper et al., 1988). Ghost nets from this fishery are also likely to have an effect on right whale entanglement, given the close proximity of the Right Whale Conservation Zone (Figure 6) (Johnston et al., 2007).

Another issue that presents itself under the water column habitat is the noise levels related to the use of pingers to mitigate harbor porpoise incidental catch. Anthropogenic noise is considered to negatively affect marine mammals. Their use to scare harbour porpoise has been documented to also act as a dinner bell for these small cetaceans and seals (Anon., 1999).

5.2.4 Economic Prosperity

Economic prosperity has been defined as maximizing the net profit from the fishery, essentially maximizing the difference between the landed value and the harvesting costs (Hilborn and Walters, 1992). The current IFMP does not address the maximization of profit explicitly. In fact, the IFMP stated that it should be fishermen that make the decisions that will determine their economic success.

The economic related objectives in the IFMP are stated to be to promote economic viability and self reliance. This is to be achieved, in part, through limited entry and improving transferability of shares and quota. These methods could be used to increase profitability.

It is always in the best interest of the industry to maximize net profit, which means maximizing the difference between the landed value of the resource and the costs of harvesting it. There are no published studies on this aspect of this fishery, however, a few general observations are offered. First, it is recognized that the fishers in this fishery are generally participants in other fisheries and use this one to supplement their income. Also the capacity in this fishery has been reduced considerably in the last decade; however there is no evidence that there is a balance between the capacity and the resource.

General economic considerations are part of the current IFMP. It is recommended that the economic objectives be further developed with an indicator system to evaluate progress toward the objectives.

5.2.5 Participatory Management

The characteristics of this community and resource are such that participatory management would likely succeed (Pinkerton, 2002). One example of these characteristics is a small community that is adjacent to the resource.

Participatory management is considered in the current IFMP for this fishery. However, it is recommended and necessary that this be further developed. There are no formally developed operational strategies, indicators or reference points for participatory management. Also, it needs to be determined the amount of participation is appropriate or if there are more meaningful ways to encourage participation.

Participatory management is occurring in this fishery and community. Implementation of participatory management through participation and consultation occurs on a regular basis. The industry participates and is responsible for the management of the resource through tools such as conservation harvesting plans. These documents represent industry written and a developed harvest strategy above what is required from DFO. Also, the industry was directly involved in producing the *Harbour Porpoise Conservation Strategy for the Bay of Fundy*. Other participatory processes in this fishery are the advisory committees and the stock assessments. This particular fishery is represented by Grand Manan Fishermen's association, a key member of many participatory management processes within the area.

5.2.6 Viable Communities

Community well being is taken as reflecting the state of individual and population health, household and national health, knowledge and culture, community functioning and equity (Canada, 2004). One of the methods to achieve subsistence of coastal communities and empowerment of users is a participatory management system.

This is an objective that is required, by this work, to meet an EAF (section 3.0), and consequently, is not formally looked at in the current IFMP. Although not explicitly documented in the current IFMP, this evaluation determined that this objective is being met for this fishery because the community still exists and this fishery has helped to maintain 20 enterprises on Grand Manan Island. From 1996 to 2001, the population of Grand Manan Island increased by 1.6 % (Statistics Canada, 2010). However, to what degree this objective is being met is unknown and would require a detailed analysis to determine.

5.2.7 Structural Objectives

The structural objectives that are required as essential, as established in this work, were evaluated against the current IFMP.

The use of indicators, references points and decision rules are present to some degree in the current IFMP. One example is the use of $F_{0.1}$ as a reference point. Another example is from the conservation harvesting plans, which set out penalties for exceeding harvest

limits. This being said, there is not a fully developed indicator system in place. The implementation of a formal Precautionary Approach or something similar would help solve this shortcoming.

There has been no published research on the costs associated with the current management regime. There are costs to the industry in the form of the dockside monitoring program, the observer program and licence fees. In addition, participation in consultation costs the industry in travel and accommodation expenses. Although the annual budget for DFO is available, these costs are not easily broken down to the Grand Manan Fishery level.

The information presented in this work was not considered simple to compile or use. There are several management documents, many only available upon request. The compilation of rules and regulations for any fishery in Atlantic Canada cannot be found under one roof.

Although some evaluation of progress is required in the current IFMP (i.e. annual reviews of CHP and overall plan review every 4-5 years), there is no evidence that this plan as a whole has been re-evaluated and it is now 9 years old. Moreover, the harbour porpoise conservation plan is 14 years old. Although no documentation of annual reviews are readily available, according to DFO personnel, advisory committee meetings are held annually, where the management of the fishery is reviewed (V. Docherty, DFO, Personal Communication, October 12, 2010).

When evaluating the management regime against the structural objectives established in this work, it is logical that an increased number of issues were identified of varying levels importance. Prioritization is necessary. There is no risk management or prioritization that occurs in the current IFMP. Priorities appear to be identified as the author(s) instinct or experience. Some risk assessment is offered for some productivity objectives, but are on the plan as a whole, not down to the Grand Manan level.

The cumulative effects and transparency are objectives established in this work, and consequently are areas that need to be addressed. In particular, DFO has been heavily criticized because the details of management decisions are not available. For example, annual quota decisions, although officially announced, are provided without any details or justifications for those decisions.

5.3 Conclusion of Audit

The current IFMP for the Grand Manan groundfish gillnet fishery is, to some extent, meeting the requirements of an EAF as established in this work. This is demonstrated through the efforts to reduce harbour porpoise bycatch, the level of industry participation and the reduction of fleet size. Garcia (2010) stated that fisheries management plans have been moving toward ecosystem considerations for the last three decades. This can be observed in this fishery. However, over the last decade there has been considerable research in what constitutes an EAF (Figure 2, Section 4). This fishery, when using the available management documents, falls short in many areas of what is now considered to

be necessary for an EAF. Some examples include the need to further develop economic and social objectives, the need for a plan evaluation and the conservation concern related to right whale entanglement.

6.0 Conclusion

There is a high demand for fisheries management systems to incorporate more holistic approaches when managing fisheries. International and national policies and legislation are dictating a more comprehensive approach to address fisheries management, taking the ecosystem as a whole into account and including more social and economic objectives. In Canada there is a need to move forward in fisheries management using international guidelines and national legislation. This is important because fisheries are important. Our fishing communities and food supply depend on sustainable harvested resources.

This paper documented the foundations and evolution of an EAF. It summarized what is being implemented by DFO Maritimes Region, and compares this to the EAF being implemented in Australia, a method which has been promoted by FAO (Bianchi, 2008). Through this evaluation it has been concluded that in addition to expanded conservation objectives, social, economic and structural objectives are essential in order to achieve a true EAF. This evaluation consolidated what the conservation objectives are, and articulated that the social and economic objectives should be economic prosperity, viable communities and participatory management, which few authors have done. Finally, an audit of a current management plan from Canada was completed to illustrate to what degree the fishery was meeting an ecosystem approach to fisheries.

The results of the case study demonstrate that the Grand Manan groundfish gillnet fishery is, to some extent, meeting the requirements of an EAF. However, improvements can be made. Canadian fisheries management can move forward by auditing their current management plans to determine if they are truly meeting an EAF. The level of development of an EAF for Canadian fisheries will be inherently variable. Any audit should utilize the expanded objectives identified in this paper.

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Appendix 1 - Australian ESD Performance Report Outline

Performance Report Heading	**Description**
1. Operational Objective (plus Justification)	*What are you trying to achieve and why?*
2. Indicator	*What are you going to use to measure the performance?*
3. Performance Measure Limit and Justification	*What levels define un/acceptable and performance and why?*
4. Data requirements / Availability	*What monitoring programs are needed?*
5. Evaluation	What is the current performance of the fishery for this issue?
6. Robustness	*How robust is the indicator and or the performance measure in assessing performance against the objective?*
7. Fisheries Management response	
o Current	*What are the management actions currently being used to achieve acceptable performance?*
o Future	*What extra management is to be introduced?*
o Actions if performance limit is exceeded	*What will happen if the indicator suggests that the performance is not acceptable?*
8. Comments and Action	*Summarize what actions will happen in the coming years.*
9. External Drivers	*What factors outside fishing control may affect performance against the objectives?*

Appendix 2 – Scotia Fundy Groundfish Integrated Fisheries Management Plan Table

General Objectives	Strategies	Measures / tactics
1.0 Conservation of the ecosystem by:		
1.1 Maintaining community diversity by protecting benthic communities susceptible to disturbance	Protect high diversity coral beds	Close area in Fundian Channel
	Protect benthic communities in the Gully	Establish the Gully as a MPA
1.2 Maintaining species diversity	Keep stock size of target species above established limits	Control fishing mortality (f)
	Minimize incidental mortalities on non-target species, particularly species at risk	Restrict directed catches and impose caps on bycatches
1.3 Maintain population diversity	Maintain spawning components of target species	Define management areas that correspond to stock distribution
1.4 Maintain trophic structure	(insufficient knowledge at this time to establish strategies)	
1.5 Maintaining productivity of populations by managing exploitation of target species	Keep exploitation rates at moderate levels	Control fishing mortality (F) through annual TACs and bycatch rules
	Avoid wastage by managing size and species selection during fishing	Specify aspects of gear construction, principally mesh size
		Implement temporary and permanent closures of areas of small fish concentration
		Restrict small mesh groundfish fisheries to specific areas
		Establish min. fish size limits
	Prevent disturbance of fish during spawning	Prohibit fishing for haddock during the spawning season in spawning areas on Browns and Georges banks
2.0 Manage the groundfish resource in a manner consistent with:		
2.1 Meeting aboriginal treaty rights	Make provisions for food, social and ceremonial fisheries	Issues communal licences
	Increase participation in the commercial fishery	Acquire and transfer licences, quotas, boats and gear to first nations
2.2 Making provisions for recreational fishing	Implement national recreational fisheries policy	Introduce licensing and catch reporting requirements
2.3 creating conditions for the economic self-reliance in the commercial fishery	Balance fleet capacity with resource availability by managing access and supporting resource sharing arrangements that allow resource users to meet their economic objectives	Limit entry through licensing
		Improve options for transferability of shares and quotas
		Resolve disagreements over historical shares
		Include all directed fisheries into existing ITQ/EA system
		Review performance of Community Management Boards
3.0 Co-Management		
	Implement the code of conduct	(to be established when appropriate)
	Undertake co-operative DFO/Industry projects	Devise policy framework for screening proposals
	Build industry management capacity	(to be established when appropriate)