AN EVOLUTIONARY LOOK AND APPLICATION TO AN ONGOING COMMITMENT: THE ECOSYSTEM-BASED APPROACH TO FISHERIES MANAGEMENT

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An Evolutionary Look and Application to an Ongoing Commitment: The Ecosystem-Based Approach to Fisheries Management

by

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ABSTRACT

Marine fisheries worldwide have relied heavily on single-species assessment models for evaluating fish stock status, and as a basis for fisheries management. The collapse of numerous fish stocks around the world, notably the Northern Cod stock of the northwest Atlantic, has many fishers, resource management experts, non-governmental fisheries organizations, academics and other management organizations questioning the efficacy of traditional single-species approaches. Consequently, resource management institutions, particularly Regional Fishery Management Organizations, are moving to a more integrated and inclusive system - the ecosystem-based approach to fisheries management.

The genesis and evolution of the ecosystem approach through to its eventual application in modern fisheries management is described, as is the effort and success organizations have experienced in advancing what is inarguably a complex and elusive concept to apply in practical terms. The analysis of a broad range of past international agreements, conservation frameworks and conventions illustrates how the ecosystem-based approach to fisheries management evolved from a loosely defined objective to what is effectively a new "tool" for fisheries management practice. Two case studies of contrasting fisheries management regimes will demonstrate how the ecosystem-based approach is being adopted and applied in a modern context.

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CBD	Convention on Biological Diversity
CEM	Conservation and Enforcement Measures
DFO	Department of Fisheries and Oceans
DMR	Maine Department of Marine Resources
EBAFM	Ecosystem-based Approach to Fisheries Management
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization
FSA	Fish Stocks Agreement
ICNAF	International Commission for the Northwest Atlantic Fisheries
IJC	International Joint Commission
ISCRWB	International St. Croix River Watershed Board
IWI	International Watersheds Initiative
MCS	Monitoring, Control and Surveillance
MPA	Marine Protected Area
NAFO	Northwest Atlantic Fisheries Organization
NRA	NAFO Regulatory Area
RFMO	Regional Fisheries Management Organization
SC	Scientific Council
UN	United Nations
UNCLOS	United Nations Convention on Law of the Sea
UNGA	United Nations General Assembly
VME	Vulnerable Marine Ecosystem

WGEAFM	Working Group on Ecosystem Approach to Fisheries Management

Section 1.0: Introduction

The United Nations Convention on Law of the Sea (UNCLOS) of 10 December 1982 lays down a comprehensive regime for law and order on the world's oceans and seas, including rules governing all uses of the resources contained within them. Over 150 countries are party to UNCLOS, which embodies the notion that all problems of oceans are interrelated and affect all nations. At the time of its adoption and implementation in 1994, the Convention incorporated traditional rules for uses of the oceans, introduced new legal concepts and regimes, and addressed new concerns for the present time and for the future (United Nations (UN), 2007). UNCLOS has become a principal platform for addressing global ocean issues that have developed into critical areas of concern for coastal states, especially fisheries management.

Fisheries management continues to evolve, incorporating many different strategies in an attempt to make fishing stocks sustainable. However, overfishing, increased harvesting and storage capacity on vessels, and the growing global demand for fish resources continue to threaten recovery efforts on depleted fish stocks in some areas. Fisheries biologists worldwide have divergent opinions on the current state of fisheries in terms of conservation and sustainability. For example, fisheries biologist Boris Worm took an alarmist outlook and documented that global fishing could be virtually wiped out by 2048 if drastic changes are not made in sustainable fishing practices (Worm et al., 2006). The report received enormous press coverage, and demonstrates the public perception of the threat posed to the oceans because of poor fisheries management practices.

Another internationally renowned fisheries biologist, Ray Hilborn, countered this prediction and cited that Worm's 2006 assessment was "apocalyptic rhetoric" and that it was sensationalized by the amount of media attention it received (Hilborn, 2010). This analysis exposed a deep divide in the marine science community over the state of fish stocks and the success of existing fishing management approaches. Numerous critiques from the marine science community, like Hilborn's, came after 2006, suggesting that Worm had greatly exaggerated the failings of fisheries management efforts and current stock levels globally. Hilborn indicated that a more balanced diagnosis of fisheries data and catch reports tells of a different story; one that is far from alarmist, but still requires changes in some fishing practices and management approaches (Hilborn, 2010). However, many conservation groups and societies within the marine conservation community appear to be unwilling to accept this counter argument and subscribe to Worm's 2048 fishing collapse prediction. Hilborn is worried that a balanced diagnosis is being almost wholly ignored in favour of rhetoric that obscures the true issues world fisheries face, as well as the correct cures for those problems (Hilborn, 2010). His message is for people to be equally sceptical of alarmist predictions and claims that everything is okay. This opens the door for exploration and application of other fisheries management approaches, like the ecosystem approach.

Regional Fisheries Management Organizations (RFMOs) are the product of international discussions and efforts of like-minded nations to cooperate in governing the use of fishery resources in a sustainable way. Under international law, countries are required to

cooperate and manage high seas, straddling fish stocks and highly migratory fish stocks (DFO, 2011). The main purpose of RFMOs is to manage, conserve and protect these fish stocks within the mandate of their respective Convention. International consensus is emerging that the adoption of ecosystem-based fisheries management is essential for sustainable fish stocks and sustainable fisheries over the long term (DFO, 2009). RFMOs have since focused on the practice and implementation of an ecosystem approach to fisheries management, while still utilizing traditional single species methods on certain fish stocks. The ecosystem-based approach to fisheries management (EBAFM) was discussed, and officially recognized in Reykjavik, Iceland 1-4 October 2001, and later implemented in 2002 by the UN, Food and Agriculture Organization (FAO) and member states of these organizations that attended the Reykjavik conference[1]

The application of the ecosystem approach to fisheries management is a relatively new concept, but ecosystem approach concepts can be traced prior to UNCLOS, and its international recognition as a viable management approach per the UN General Assembly (UNGA) Resolution 61/105[2]. The first section of this paper presents an analysis and discussion of the evolution of the ecosystem approach, its different applications to fisheries management, and how it is utilized and applied in fisheries management

[1] Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem. Reykjavik, Iceland, 1-4 October 2001.

[2] United Nations, A/Res/61/105 - Sustainable fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention for Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish stocks, and related instruments

practices today. The second and third sections of this paper attempt to identify a universal working definition for the ecosystem approach. This is done by tracing the origin and evolution of the ecosystem approach through different international vehicles, to its application in contemporary fisheries management.

The fourth and fifth sections of the paper present two case studies and attendant analyses of the ecosystem approach applied in fisheries management. The first case study focuses on a RFMO, the Northwest Atlantic Fisheries Organization (NAFO). Broadly speaking, NAFO's mandate is to provide scientific advice and fisheries management on straddling fish stocks in the northwest Atlantic. NAFO has been widely and publicly criticized for its fisheries management failure, particularly during the 1990s when foreign overfishing was rampant, and most prominently during the "Canada-Spain Turbot War" of 1995. NAFO went through a radical reform in 2005 as part of its commitment for change, and to adopt the ecosystem approach in its fisheries management mandate. NAFO reform is ongoing, but this RFMO now includes a commitment for incorporating and identifying Vulnerable Marine Ecosystems (VMEs), and how to protect them within the overall framework of managing fisheries in the NAFO Regulated Area (NRA). This commitment is substantiated per the terms of UNGA Resolution 61/105.

The second case study is on a transboundary watershed board, the International Joint Commission's (IJC) International St. Croix River Watershed Board (ISCRWB). The

Board helps to prevent and resolve disputes over the boundary waters of the St. Croix River, monitors the ecological health of the waters, and ensures dams comply with the Commission's Orders of Approval (IJC, n.d.). The ISCRWB has adopted the International Watersheds Initiative (IWI), an initiative which promotes an integrated ecosystem approach for managing the St. Croix River watershed. In particular, the main emphasis of this case study will be on the Board's management of the alewife (*Alosa psuedoharengus)* within the St. Croix River watershed, while utilizing the IWI.

The last section of the report contains concluding thoughts and comments on the evolution and ongoing development of EBAFM. The analysis of the two case studies will help explain different variations of EBAFM and its application to fisheries management.

Section 2.0: The Ecosystem Approach

2.1 What is the Ecosystem Approach?

Before any attempt at discussing the ecosystem approach, the term "ecosystem" itself must first be defined. Article 2 of the UN Convention on Biological Diversity (CBD) (1992a) defines an ecosystem as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." This is a universal working definition of what constitutes an ecosystem, arising from the most prominent source, and is that which will guide all following discourse on the ecosystem approach in this document.

Different definitions of the ecosystem approach have been constructed and presented to suit particular agendas or discussions. The most popular and widely used definition of the ecosystem approach has resulted from the Fifth Conference of Parties to the Convention on Biological Diversity. Decision V/6, Annex A, Section 11 defined the ecosystem approach as, "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way" (Secretariat, CBD, 2005).

Despite this internationally adopted definition, many different interpretations and variations have been utilized by governments, environmental management organizations, non-governmental environmental organizations, and other stakeholders. As a result, each

actor utilizes their own understanding of the ecosystem approach and its interpretation on the management of resources. This complicates things if a universal definition and method of the ecosystem approach to management is sought and applied. However, this can also be beneficial as it indicates how adaptable the concept of an ecosystem approach can be in different applications.

2.2 The Process that Led to the Ecosystem Approach to Fisheries Management

The exact and specific origin of the ecosystem approach is unknown. In order to put into context how the ecosystem approach has evolved, it is important to look at specific legislation, documents, and conventions that capture an all inclusive international audience. The UN provides this foundation. The first relevant reference to the ecosystem in an international convention, legislation or vehicle was during the 1971 Ramsar Convention on Wetlands of International Importance. The Ramsar Convention was the first intergovernmental treaty to promote integrated management practices for wetlands and river basins, all essential for ensuring sustainable water resources, and survivable ecosystems in the future (Convention on Wetlands of International Importance, 1971). This Convention paved the way for the 1972 Stockholm Declaration on the UN Conference on Human Development, which is arguably where discussion and priority of ecosystems began. Contained within this Convention are a number of principles that pertain to ecosystems:

Principle 2:

"The natural resources of the earth, including the air, water, land, flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate."

Principle 3:

"The capacity of the earth to produce vital renewable resources must be maintained and, wherever practicable, restored or improved."

Principle 4:

"Man has a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat, which are now gravely imperilled by a combination of adverse factors. Nature conservation, including wildlife, must therefore receive importance in planning for economic development.[3]" (UN, 1972)

The conference set the wheels in motion for a number of other major international agreements that discussed and focused on various aspects of the ecosystem. Table 2.1 on page 9 provides a listing of these agreements. This "iterative" process eventually led to what can be described as fundamental components of an ecosystem approach. Through each declaration, convention and conference, the importance of ecosystems has and continues to be recognized in different areas of conservation and management. From a historical standpoint, the ecosystem approach has been introduced and used mostly for terrestrial purposes; however, it evolved to include more marine activities. The inclusion of EBAFM was officially recognized and addressed for implementation during the 2001 Reykjavik Conference on Responsible Fishing in the Marine Ecosystem. The

[3] 21st plenary meeting. 16 June 1972 Chapter 11. Declaration of the United Nations Conference on the Human Environment.

incorporation of EBAFM became more frequent thereafter, as many RFMOs and Regional Fisheries Bodies adopted it in their mandate(s). NAFO was one of them.

Table 2.1: Chronological List of Relevant International Agreements and Frameworks for the Evolution of the Ecosystem Approach.

1971 Ramsar Convention on Wetlands of International Importance
1972 Stockholm Declaration of the UN Conference on Human Development
1973 Convention on International Trade of Endangered Species of Wild Flora and Fauna
1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals
1980 Convention for the Conservation of Antarctic Marine Living Resources
1982 UN Convention on Law of the Sea
1991 Global Environment Facility
1992 Declaration of the UN Conference on Environment and Development
1992 Helsinki Convention on the Protection and Use of Transboundary Watercourses
1995 UN Agreement on Straddling and Highly Migratory Fish Stocks
1995 FAO Code of Conduct for Responsible Fisheries
1995 Jakarta Mandate on Marine and Coastal Biological Diversity
2001 Reykjavik Conference on Responsible Fishing in the Marine Ecosystem[4]
2002 Johannesburg World Summit on Sustainable Development
2006 UN General Assembly Resolution on Sustainable Fisheries

Source: Adapted from UN Atlas of Oceans, Garcia, S.M., Fishery Resource Division.[5]

Next, it is important to explore some of these major agreements and analyze how the ecosystem approach has been made a relevant and crucial element in fisheries management today. The interpretation and use of UNCLOS, the CBD, UN Agreement on Straddling and Highly Migratory Fish Stocks, FAO Code of Conduct for Responsible Fisheries, Reykjavik Conference on Responsible Fishing in the Marine Ecosystem and lastly, the 2006 UNGA Resolution 61/105 will be examined for this purpose.

[4] International recognition and implementation of an "ecosystem based approach" to fisheries management
[5] Accessed at http://www.oceansatlas.org/world_fisheries_and_aquaculture/html/govern/capture/ecosysmng/default.htm

Section 3.0: International Conventions and Other Legal Instruments

3.1 United Nations Convention on the Law of the Sea

UNCLOS deals with all matters related to oceans and seas, and provide rules for the regulation of all uses for them. The Convention also establishes a framework for the development of conservation and management measures concerning marine resources and scientific research within the Exclusive Economic Zone (EEZ) of a State, as well as on the high seas. This framework has become vital in establishing the ecosystem approach and the evolution and incorporation of VMEs in present-day fisheries management. Certain sections of UNCLOS make reference to the conservation, protection, preservation and management of the marine environment, which alludes to a concept on how the ecosystem approach has evolved into management practice. UNCLOS was officially ratified in 1994.

Part VII, Section II of UNCLOS outlines provisions dealing with the conservation and management of the living resources of the high seas. All States reserve the right for their nationals to engage in fishing on the high seas and they have the duty to take, or to cooperate with other States to ensure such measures for the conservation of the living resources of the high seas (UNCLOS, 1982, Articles 116 & 117). It also encourages State cooperation in the conservation and management of living resources in the areas of the high seas and to take the appropriate measures for the conservation of the living resources concerned (UNCLOS, 1982, Article 118). Under the general provisions for conservation of the living resources of the high seas, States also must take into consideration the

effects on species with a view to maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened (UNCLOS, 1982, Article 119(1.b.)). Appropriate measures for conservation of the living resources and the consideration of effects on species can consequentially include the same context for marine ecosystems, as it is essential to such species. This section of UNCLOS indicates a conservation and protection ethic that pertains to the ecosystem approach.

Part XII of UNCLOS outlines provisions for the protection and preservation of marine ecosystems. These provisions are very broad and applicable to fisheries activities on a global scale. Article 192 of UNCLOS specifically indicates that States have the obligation to protect and preserve the marine environment. They have the sovereign right to exploit their natural resources, but only in accordance with their duty to protect and preserve the marine environment (UNCLOS, 1982, Article 193). The majority of this part of UNCLOS deals with the protection of the marine environment and ecosystems from marine pollution. However, Article 194(5) reads:

> "The measures taken in accordance with this Part shall include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life." (UNCLOS, 1984, Article 194(5))

Part XII highlights and makes reference to various forms of ecosystems and the life contained within them as an important concern. As indicated, Part XII revolves mainly

around marine pollution, but the scope of Article 194(5) can also be broadened or interpreted as other activities/perturbations that damage fragile marine ecosystems, such as adverse impacts of bottom fishing on the high seas.

3.2 Convention on Biological Diversity

The 1992 CBD was a major treaty that was signed at the UN Conference on Environment and Development in Rio de Janeiro and provides an international framework for conservation and ecologically sustainable development, while factoring the importance of biodiversity into any decision-making. It is a generic Convention that does not specifically mention fisheries per se; however, it is meant to apply all terrestrial and marine sectors into its framework. The treaty defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (UN, CBD, 1992a, Article 2).

The CBD urges Parties to integrate biodiversity conservation policies and strategies with cross-sectional plans, and such plans include State adoption of in-situ and ex-situ conservation measures. Such in-situ measures under the Convention include establishing systems for protected areas for conserving biodiversity, regulation and management of biological resources, and to promote ecologically sustainable development in areas that

are adjacent to protected areas to limit negative impact(s) on that area and to the protected area (UN, CBD, 1992a, Article 6b).

Under the CBD, in-situ conservation practices refer to three key issues - protected areas, biological resources, and ecosystems and habitats. All Contracting Parties under the Convention are supposed to follow a number of obligations pertaining to these three areas. These obligations are integral, as they set the conservation and management foundation for dealing with such areas. A lot can be extracted from these obligations and applied to fisheries management. When dealing with marine ecosystems, all three measures - protected areas, biological resources, ecosystems and habitats - are relative and essential to their identification, monitoring and protection. Such obligations include:

- The establishment of a system of protected areas for conserving biodiversity;
- The development of guidelines for the selection, establishment and maintenance of protected areas;
- The regulation and management of biological resources that are important for conserving biodiversity within protected areas;
- The rehabilitation and restoration of degraded ecosystems, through the development and implementation of management plans and strategies; and
- The promotion in the protection of ecosystems, natural habitats and the maintenance of viable populations of species (UN, CBD, 1992a, Articles 8a-f).

Like UNCLOS, the recurring theme in the CBD is for Parties to develop and implement measures to control and manage the risks associated with potentially threatening

activities on the ecosystem. To ensure such control and management measures, Parties are required to regulate and manage the collection of biological resources from habitats to ensure that the survival of species, populations and ecosystems are not threatened. Also, funding and research is encouraged to promote conservation under the biodiversity principle (UN, CBD, 1992a, Article 9). The significance of ecosystems, their conservation and management are being highlighted here, and the articles mentioned in these areas of the CBD are quite applicable to fisheries management. This is especially true in terms of protecting ecosystems that are integral to fish stocks, including straddling and highly migratory stocks. This is accomplished usually through restricting fishing in areas that have such ecosystems. This is the case NAFO makes through the identification and protection of VMEs, which are addressed in the next section of this paper.

3.3 United Nations Agreement on Straddling and Highly Migratory Fish Stocks

The Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling and Highly Migratory Fish Stocks, also known as the Fish Stocks Agreement (FSA), was adopted in August 1995. The agreement's objective is to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks through effective implementation of the relevant provisions under UNCLOS (UN, FSA, 1995, Article 2). Also, the agreement imposes certain obligations that Parties must consider to protect the marine ecosystem when implementing the appropriate measures for the long-term conservation and protection of these fish stocks.

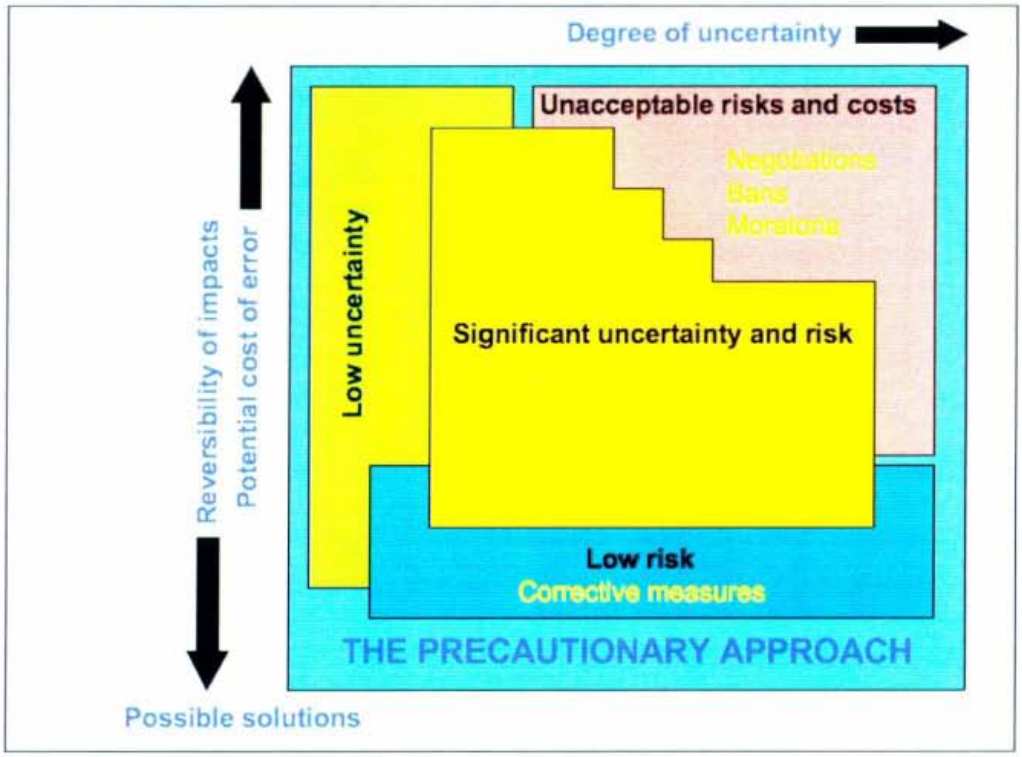
The agreement requires that States ensure the sustainable utilization of fish stocks and assess the impacts of fishing on the marine environment. This means Parties must evaluate the impacts of their fishing, other human activities, and environmental factors such as pollution, on target species, species that are part of the same ecosystem, and species that are associated with or dependent upon a target species of that ecosystem (UN, FSA, 1995, Article 5).

The precautionary principle, one that is often utilized in conjunction with the ecosystem approach, is mentioned in the FSA. Originally, the primary foundation and globally accepted definitions result from Principle 15 of the Rio Declaration:

> "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific uncertainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." (UN Environment Programme, 1992b, Rio Declaration on Environment and Development)

Article 6, "Application of the precautionary approach," in the FSA outlines seven ways in which the precautionary approach should be applied. Part 3d, in particular, indicates data should be collected and research programs developed to assess the impact of fishing on non-target and associated or dependent species and their environment, and adopt plans which are necessary to ensure the conservation of such species and to protect habitats of special concern (UN, FSA, 1995, Article 6).

Under the EBAFM, the application of a precautionary approach (Figure 3.1) is particularly important because it is expected that uncertainty will be considerably greater than under traditional management focused on target resources only (FAO, 2005a). However, it also utilizes the best scientific information that is available, often utilizing the data that is obtained through single-species methods. Because uncertainty affects all elements of the fishery system in varying degrees, some degree of precaution is required at all levels of the system. This is extremely important as poor management decisions can affect an entire ecosystem.



Source: Modified from FAO, 2005b.

Figure 3.1: Diagram of the Precautionary Approach for Fisheries Management. The precautionary approach for fisheries management is about being cautious when scientific knowledge and data is uncertain. It is also about not using the absence of adequate scientific information as a reason to postpone action or failure to take action to avoid serious harm to fish stocks or their ecosystem. As indicated in the diagram, there is significant risk associated with uncertainty. The potential cost of error and the reversibility of impacts are affected by this uncertainty. With low uncertainty, preventative and corrective measures can be applied over time. With high uncertainty, unacceptable risks and costs must be handled with mitigation measures, such as negotiations, bans or moratoria. NAFO has developed a similar precautionary approach based on this FAO model.

The FSA also places RFMOs in a pivotal and central position in terms of its implementation. RFMOs provide the primary mechanism through which States should cooperate to achieve enhanced resource conservation and management. RFMOs are still

grappling with practical aspects of the FSA's implementation, such as how to apply the precautionary principle in fisheries management, how to implement ecosystem management, and how to address transparency (FAO, 2005c). NAFO has tried to accomplish this through the inclusion of VMEs, which has linkages to Article 6 of the FSA where it mentions "habitats of special concern."

3.4 Food and Agriculture Organization Code of Conduct for Responsible Fisheries

The Code of Conduct for Responsible Fisheries was initiated earlier in 1991 by the FAO's Committee on Fisheries, and it was finally adopted on 31 October 1995. The Code of Conduct is a voluntary and non-binding instrument, but it contains provisions largely based on international law as it links other international fisheries obligations, including those established previously under UNCLOS. The FAO Code sets out principles and international standards of behaviour for responsible practices, with a view of ensuring the effective conservation, management and development of living aquatic resources, and due respect for the ecosystem and biodiversity (FAO Code of Conduct for Responsible Fisheries, 1995, Introduction). This sets the stage for the inclusion of damage on the ecosystem caused by certain types of fishing and fishing gear.

The general principles of the Code of Conduct assert that States and users of living aquatic resources should conserve aquatic and marine ecosystems, and the right to fish carries with it the obligation to do so in a responsible matter to ensure effective

conservation and management of living aquatic resources (FAO Code of Conduct for Responsible Fisheries, 1995, Article 6.1). This ethic is instilled and enshrined to commit/encourage States and users to use an ecosystem approach in utilizing their right to fish. There are two crucial principles worthy of mention that are covered in the general principles of the Code of Conduct: fishing gear and fisheries habitats. First, the code makes reference to "environmentally friendly" fishing gear. It states that selective and environmentally safe fishing gear and practices should be further developed and applied, to the extent practicable, in order to maintain biodiversity and to conserve the population structure and aquatic ecosystems and protect fish quality (FAO Code of Conduct for Responsible Fisheries, 1995, Article 6.6). Second, it references the importance of "critical" fisheries habitats by stating:

> "...all critical fisheries habitats in marine and fresh water ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas, should be protected and rehabilitated as far as possible and where necessary. Particular effort should be made to protect such habitats from destruction, degradation, pollution and other significant impacts resulting from human activities that threaten the health and viability of the fishery resources." (FAO Code of Conduct for Responsible Fisheries, 1995, Article 6.8)

Both of these provisions have the framework to provide effective protection of marine ecosystems (within the precautionary principle), as it indicates the importance of marine ecosystems to the fishery and how non-environmentally friendly fishing gear can degrade such marine ecosystems. Fishing gear can change the living and non-living environment in which the target species and other related resources live. Ecosystem damage can come from the very nature of the fishing gear or from the inappropriate use of otherwise

acceptable gear, like using trawls in areas where there are coral reefs. Modern towed gear, such as trawls and dredges, damage the ocean bottom and the addition of heavier gear and rigging increase the damage caused on dynamic, soft bottom habitats like sand dunes and even stable, hard and high structured habitats like coral reefs and sponge beds (NAFO's VME examples) (Garcia et al., 2003). These topics are integral reasons for why the development and incorporation of an EBAFM is needed. The arguments being made here are that bottom fishing and the gear being used can harm VMEs and that new management protocols are needed to ensure that they are protected.

3.5 Reykjavik Conference on Responsible Fishing in the Marine Ecosystem

The Reykjavik Conference on Responsible Fishing in the Marine Ecosystem took place on 1-4 October 2001, and it marked the first concentrated effort to implement the EBAFM. There had been significant build up in the previously referenced international conferences and frameworks to lean towards an ecosystem approach, and the Reykjavik Conference was the result of all this discussion. The central theme of the Reykjavik Conference was an examination of the implications of the global trend towards ecosystem-based fisheries management for capture fisheries, and also to provide an in-depth analysis on important global issues relating to fisheries and the implementation of the FAO 1995 Code of Conduct for Responsible Fisheries (FAO, 2002a). The rationale remained that most fishery resources remain either fully exploited or overexploited on a global scale.

The Reykjavik Conference acknowledged that previous fisheries management methods have been inadequate and that in order to keep fishing sustainable, an ecosystem-based approach was necessary. It recognized the importance of such an approach, as it confirmed that the objective of including ecosystem considerations in fisheries management is to contribute to long-term food security and human development and to assure the effective conservation and sustainable use of the ecosystem and its resources (FAO, Reykjavik Declaration, 2002b, Appendix I). Referring to UNCLOS, the FSA and the FAO Code of Conduct, the Reykjavik Conference took into account the impacts of fisheries on the marine ecosystem, and the impacts of the marine ecosystem on fisheries. These impacts include: direct impacts of overfishing; modifying community species composition and genetic diversity through selective targeting; impacts on non-target species; incidental mortality from lost or abandoned gear; direct impact on the sea bed; and destructive illegal "fishing gear" such as dynamite and poisoning (FAO, 2002a).

The Reykjavik Declaration was the official document generated from the Conference. The document cemented much of the ecosystem discussions and reiterated the importance of the principles of the FAO Code of Conduct to Responsible Fisheries with respect to UNCLOS, as it set out the rights and duties of States with respect to the use and conservation of the ocean and its resources, including the conservation and management of living marine resources (FAO, Reykjavik Declaration, 2002b, Appendix I). The Declaration also mentioned the role of fisheries management organizations, both regional and international, in taking into account ecosystem considerations when

managing and conserving the marine environment, and indicates the importance of such organizations to strengthen and improve management to incorporate these ecosystem principles (FAO, Reykjavik Declaration, 2002b, Appendix I). Organizations like NAFO fall under this section, and it is clear that this document revolutionized the way such organizations look at fisheries management with respect to the ecosystem. This Declaration finally established the ecosystem-based approach towards fisheries management, but in a very generic sense, like broadly including marine environments. Through this Conference, a more narrow focus developed on marine ecosystems and the management of ecosystems in the UNGA Resolution 61/105.

3.6 United Nations General Assembly on Sustainable Fisheries Resolution 61/105

The 2006 UNGA Resolution 61/105 on Sustainable Fisheries is the basis for the majority of changes to the way States, both individually and collectively through RFMOs, approach fisheries management. The resolution focuses on the sustainable management of deep sea fish stocks and protection of VMEs from significant and adverse impacts from bottom fishing activities. For the first time, a resolution focuses on the kind of marine ecosystem degradation from a specific fishing source - bottom fishing. Part of this process includes the detection, identification, and protection of VMEs.

The UNGA Resolution 61/105 emphasizes the significance ecosystems play on fisheries. By incorporating VMEs in fisheries management through the ecosystem approach, it

delivers a simplistic, but very important message; by protecting the ecosystem, you protect species that occupy it, for the long-term. The Resolution specifically calls for States to take action to protect VMEs, including seamounts, hydrothermal vents and cold water corals, from destructive fishing practices and recognizing the immense importance and value of deep sea ecosystems and the biodiversity they contain (UNGA 61/105, 2006, Section X, Paragraph 80). The provisions provided in UNGA 61/105 encompass a wide range of elements that are aimed to ensure such objectives are achievable. The Resolution encourages States to apply the ecosystem approach by 2010, and it notes the CBD, FAO Code of Conduct, the Reykjavik Declaration and other relevant discussions to act as guidelines for the implementation of the EBAFM (UNGA 61/105, 2006, Section X, Paragraph 76).

Many RFMOs were established before the FSA, FAO Code of Conduct for Responsible Fisheries and the Reykjavik Conference on Responsible Fishing in the Marine Ecosystem and UNGA 61/105, so it is not surprising that few of them incorporate the EBAFM. RFMOs established more recently do reflect and even mention the EBAFM. However, the adoption of the ecosystem approach is a function of the date that it was implemented and pre-existing RFMOs, like NAFO, needed to amend their Conventions to adopt the approach. Prominent RFMOs in a position similar to NAFO[6] include:

[6] In 2005, NAFO began discussion on the ecosystem approach to fisheries management and soon announced its commitment to an ecosystem approach, reflected in its amended and updated Convention.

- The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean
- Convention for the Conservation and Management of Fisheries Resources in the South East Atlantic Ocean
- Convention on Future Multilateral Co-operation in North-East Atlantic Fisheries
- Convention for the Conservation of Salmon in the North Atlantic Ocean
- International Convention for the Conservation of Atlantic Tunas (Currie, n.d)[7]

The Resolution also mentions an important set of obligations on fishing nations to protect not only ecosystems within their own jurisdiction from bottom fishing, but within areas beyond national jurisdiction. This is aimed to significantly enhance the protection and sustainable management of fisheries and VMEs beyond national jurisdiction, which would have a better long-term effect in the successful management of fisheries (UNGA 61/105, 2006 Section X, Paragraph 86). It also mentions the role of States, individually and through RFMOs, is to take over this developing role as it is recognized that RFMOs are ideally the only bodies with the existing infrastructure necessary to achieve the deadlines on time when dealing with the UNGA Resolution 61/105. RFMOs already have the infrastructure in place and the ability to act as a vehicle to strengthen international cooperation, promote transparency, address non-members, and enhance monitoring, control and surveillance (MCS) measures. RFMOs' activities may lead to improved national fisheries governance and harmonized regional measures. These measures include

[7] List of respective RFMOs adapted from Currie, D. (n.d). "Ecosystem-Based Management in Multilateral Environmental Agreements: Progress towards Adopting the Ecosystem Approach in the International Management of Living Marine Resources." World Wildlife Fund International, Global Species Program.

MCS, information exchange and scientific advice and statistics. Single States or other resource management bodies simply do not have the resources or capacity to do all this. It is understood that UNGA 61/105:

> "Calls upon regional fisheries management organizations/arrangements with the competence to regulate bottom fisheries to adopt and implement measures, in accordance with the precautionary approach, ecosystem approaches and international law, for their regulatory areas as a matter of priority, but not later than 31 December 2008." (UNGA 61/105, 2006, Section X, Paragraph 83)

NAFO is an RFMO that has gone through change to incorporate ecosystem-based approaches in its fisheries management. The next section examines NAFO as an RFMO, and its metamorphosis from the 1978 Convention to the amended 2008 Convention.

Section 4.0: Case Study One - The Northwest Atlantic Fisheries Organization and its Adaptation to Change

4.1 The Northwest Atlantic Fisheries Organization - International Commission for the Northwest Atlantic Fisheries and the 1978 Convention

The Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries, signed on 24 October 1978 in Ottawa, came into force on 1 January 1979 following ratification, acceptance and approval by seven signatories: Canada, Cuba, the European Economic Community, German Democratic Republic, Iceland, Norway, and the Union of Soviet Socialist Republics. This Convention established NAFO and replaced the 1949 International Convention for the Northwest Atlantic Fisheries and the International Commission for the Northwest Atlantic Fisheries (ICNAF) (NAFO, n.d.)

Prior to the 1978 Convention, ICNAF was responsible for management of the fisheries of the Northwest Atlantic outside the territorial seas of the coastal States, west of 42° West longitude, between 39° West and 78° 10' North latitude (NAFO, n.d.). Fish stocks were managed often through an ill-defined and ad hoc means. In ICNAF's early years of the 1950s, it was given the mandate "to make possible the maintenance of a maximum sustained catch from the ICNAF fisheries." This was based on scientific investigations and the concept of maximum sustained catch was later modified to allow for "joint action to achieve the optimum utilization" made on the basis of scientific investigations, along with economic and technical considerations. This continued until 1971 when it was

discovered that there were benefits to be gained from not harvesting the maximum sustainable level (NAFO, n.d).

Originally, ICNAF did not establish an organizational structure for scientific matters, although it was charged with being responsible in the field of scientific investigation for obtaining and collating the information necessary for maintaining fish stocks that support international fisheries in the Convention Area. The Standing Committee on Research and Statistics (STACRES) was established and shifted its focus for scientific endeavour (NAFO, n.d.). Research and statistic collection were undertaken by agencies of Contracting Parties and submitted to STACRES. An early function of STACRES addressed the fundamental question of what to do with fisheries and biological data. STACRES developed specifications for the nature of the data to be collected, how to store it and disseminate it.

ICNAF came at a time when the exploitation of marine fisheries was escalating after World War II. This was a time when technological advances in fishing vessels, fishing innovation and capacity attracted a huge influx of modern fishing platforms from many nations to fish the highly productive fishing grounds, and relatively untapped cod and groundfish resources of the Northwest Atlantic. ICNAF struggled for 20 years with ineffective technical measures for regulating its fisheries, and failed by not persuading member States to agree earlier on effective conservation measures for the fish stocks

(NAFO, n.d.). In 1978, NAFO replaced ICNAF and the Convention aimed to rectify these problems, as there was no true management regime in place.

The 1978 NAFO Convention saw the incumbent RFMO emulate its predecessor, but under a different structure. NAFO established and organized three bodies: the General Council, Fisheries Commission (FC) and Scientific Council (SC). The creation of these bodies made a clear distinction between coordinating and administrative functions, conservation and management activities, and scientific processes. The new Convention also provided consistency provisions to address the relationship between the actions of the FC in the NRA and domestic management measures taken by coastal States (NAFO, n.d.). This proved to be inefficient as considerations for other fish species or the broader marine ecosystem were often disregarded. Fisheries management decisions based on the best scientific advice was often dismissed by member States and there was no consideration of the "precautionary principle". As a result, the narrow view taken by ICNAF and NAFO harmed the long-term health of many fish stocks in the Northwest Atlantic and contributed to the overfishing of straddling fish stocks, particularly through the late 1970s, the 1980s and early 1990s by foreign and domestic fishing vessels.

Unilateral decisions on quota setting without consequence, uncompromising decision-making and fishing abuse were common during ICNAF and even within NAFO during the 1978 Convention era. Any decision that was made was often undermined by the

frequent use of objections. This dissension amongst members proved to be costly as it, along with other compounding factors like the inaccuracies of stock data versus estimated catches during these overfishing periods, contributed to the collapse of one the most important groundfish stocks in the Northwest Atlantic, the Northern Cod (*Gadus morhua*). The culmination of all these anthropogenic factors, including the lack of a precautionary and ecosystem view, the lack of compliance by NAFO member States to adhere to the Convention and the convoluted nature of the Convention also indirectly promoted the decimation of a large quantity of other groundfish stocks, including straddling stocks.

In addition, during the 1978 Convention era, poor or unreliable data provided to NAFO by its members and ineffective monitoring due to a lack of compliance resulted in both Canada and NAFO overestimating the abundance of groundfish, cod in particular, and establishing artificially high Total Allowable Catches (TACs). NAFO and Canadian Policy makers set quotas that placated member States, rather than to maintain the stocks.

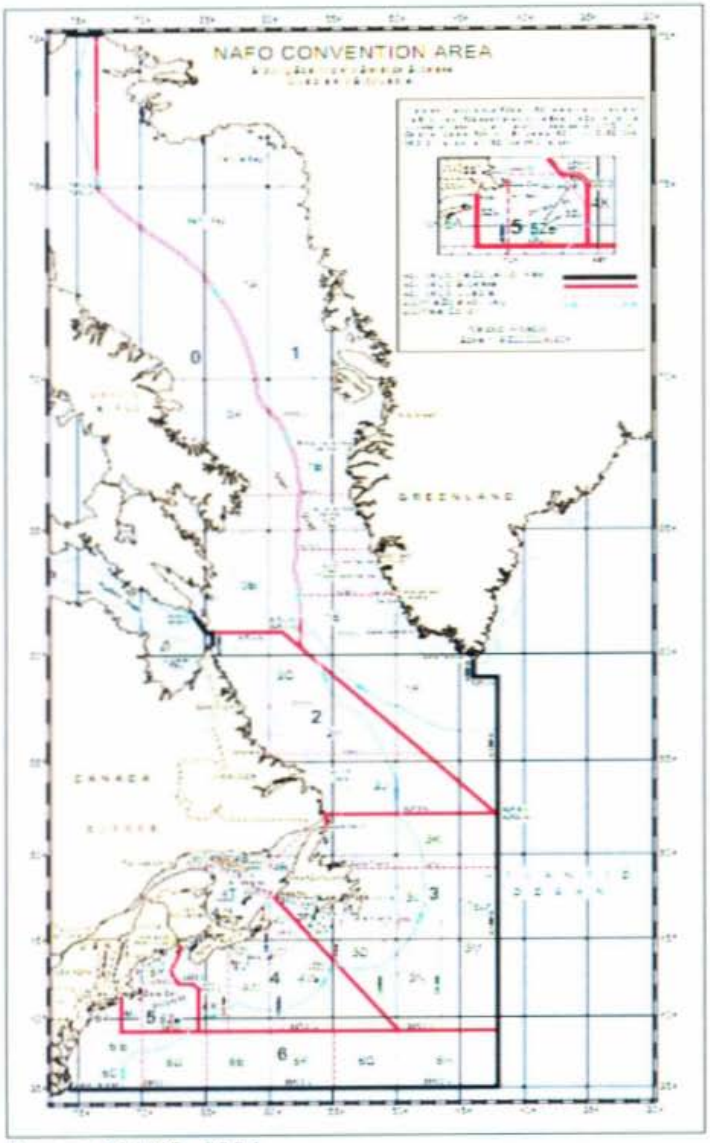
More recently, natural factors such as seal predation, changing oceanographic conditions and poor recruitment exacerbated the problem, but to a lesser extent compared to the tremendous impact of overfishing.

4.2 The 2005 Reform of Northwest Atlantic Fisheries Organization

NAFO is responsible for managing fishing activities in the Northwest Atlantic region. NAFO's overall objective is to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area (NAFO, n.d.) (Figure 4.1). This area encompasses a large portion of the Atlantic Ocean and includes the 200-mile EEZ of coastal States (Canada, Denmark, France and the United States). The management of salmon, tuna, marlins and whales and sedentary species are not within the purview of NAFO (NAFO, n.d.).

In keeping with its commitments stemming from UNGA 61/105, NAFO began a reform in 2005. The reform concentrated on three main areas:

1. An updated Convention to replace the 1978 Convention;
2. An adoption of the ecosystem approach to fisheries management; and
3. An updated protocol on Monitoring, Control and Surveillance (MCS)



Source: NAFO, 2004.

Figure 4.1: NAFO Convention Area.

The adoption of an ecosystem approach by NAFO reflects the responsibility that the RFMO has taken towards the negative impact of fishing activities on species and marine ecosystems. This was recommended by both the UNGA Resolution 61/105 and NAFO's

MCS measures pertaining to fishing activities and newly refocused ecosystem implemented activities.

NAFO's amended Convention was adopted in September 2007 in Lisbon, Portugal. NAFO member States (Table 4.1) are still in the process for ratifying the new Convention. The adopted text has to be ratified by at least three-fourths of the Contracting Parties in order to make it binding. A new, updated objective from NAFO came as a result of the Convention:

> "...to ensure the long term conservation and sustainable use of the fishery resources in the Convention Area and, in doing so, to safeguard the marine ecosystems in which these resources are found." (NAFO Convention, 2007a, Article II)

Table 4.1: Current NAFO Contracting Parties and Member States.

Canada	**Cuba**
Denmark (Faroe Islands & Greenland)	**European Union**
France (Saint Pierre et Miquelon)	**Iceland**
Japan	**Republic of Korea**
Norway	**Russian Federation**
Ukraine	**United States of America**

Source: Adapted from NAFO, n.d.

This Convention also encompasses many of the themes of previous agreements such as the CBD, FSA, FAO Code of Conduct for Responsible Fisheries, the Reykjavik Declaration and of the UNGA Resolution 61/105. This gives evidence of their evolutionary importance and suggests NAFO concurs with an EBAFM including the safeguarding of the marine environment, conserving its marine biodiversity, minimizing the risk of long term or irreversible adverse effects of fishing activities, and taking into account the relationship between all components of the ecosystem (NAFO Convention, 2007a, Article II). Following the guidance provided by these international frameworks, Contracting Parties play a major role in terms of NAFO's ability to uphold its commitments and follow its objectives.

An organization is only as good as its members and thus, can only operate both effectively and sufficiently if its members contribute. That is why listed within the Convention are a number of provisions Parties must follow if NAFO is to have any lasting and effective impacts on its efforts to fulfill its duties. For example, Parties, individually or collectively, must collect and exchange scientific, technical and statistical data and knowledge pertaining to living resources and their ecosystems in the Convention Area and provide it to the NAFO Secretariat. Additionally, Contracting Parties must implement NAFO's Convention and any conservation and management measures and regularly submit to NAFO a description of the steps taken. Each Contracting Party also has specific obligations and rules to follow under the Convention pertaining to their fishing activities and the monitoring of the marine environment. However, if NAFO is to

be successful, regular and up-to-date information has to be provided by each Contracting Party. NAFO realizes participation in the new Convention is predicated on the Contracting Parties willingness to do so.

4.3 Towards Implementing United Nations General Assembly Resolution 61/105 in the Northwest Atlantic Fisheries Organization

The 2005 NAFO reform process had many significant events leading up to the inclusion of the ecosystem approach to its fisheries management mandate. One such integral event was the 2005 St. John's Declaration. This Declaration reiterated the importance of the marine ecosystem on fisheries, and that more could be done by RFMOs, including NAFO, to protect potentially sensitive marine areas. In response to the Declaration, NAFO focused its attention in 2006 on four existing seamounts located in the NRA (Table 4.2) and closed these areas from 1 January 2007 to 31 December 2010, to all fishing activities involving demersal fishing gears (NAFO, CEM, 2008a). There is evidence of limited bottom fishing in some of these areas, while little to none elsewhere. This would allow small scale and cautious exploratory fisheries to gather data which would be provided to the NAFO Secretariat. It would also enable NAFO to improve its knowledge of these seamount areas and better assess the impact of fishing activities on these specific areas.

In June 2007, the NAFO SC held a meeting to discuss information regarding fishing on and around the four closed seamount areas in the NRA. Fishing activity from January

2003 to March 2007 was assessed using information from Vessel Monitoring Systems (VMS), observer records and catch and effort databases. It was found that there was no evidence of commercial fishing on the Orphan Knoll, a few exploratory tows on the Newfoundland Seamounts and only limited commercial fishing on the New England and Corner Rise Seamounts, with evidence that only one seamount within the Corner Rise Seamounts area closure was repeatedly fished over successive seasons (NAFO, 2007b).

Table 4.2: Coordinates of 2008 Closed Seamounts in the NRA.

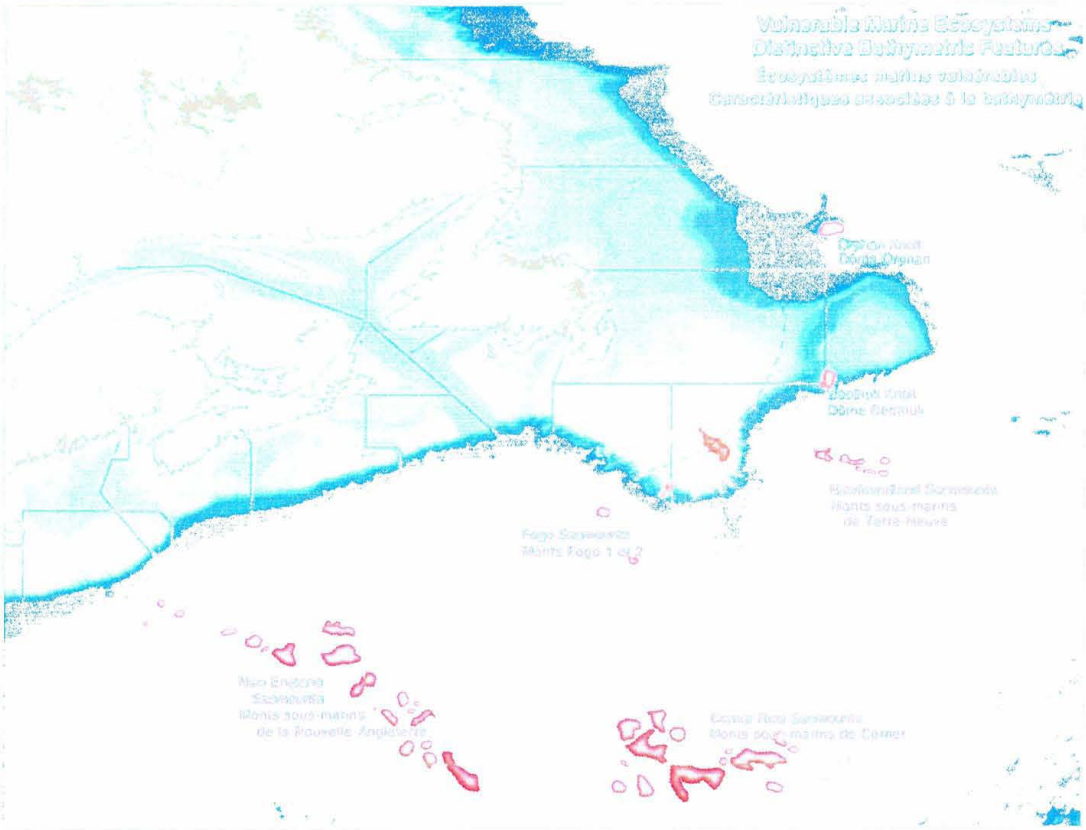
Area	Coordinate 1	Coordinate 2	Coordinate 3	Coordinate 4
Orphan Knoll	50°00'30"N 45°00'30"W	51°00'30"N 45°00'30"W	51°00'30"N 47°00'30"W	50°00'30"N 47°00'30"W
Corner Seamounts	35°00'00"N 48°00'00"W	36°00'00"N 48°00'00"W	36°00'00"N 52°00'00"W	35°00'00"N 52°00'00"W
Newfoundland Seamounts	43°29'00"N 43°20'00"W	44°00'00"N 43°20'00"W	44°00'00"N 46°40'00"W	43°29'00"N 46°40'00"W
New England Seamounts	35°00'00"N 57°00'00"W	39°00'00"N 57°00'00"W	39°00'00"N 64°00'00"W	35°00'00"N 64°00'00"W

Source: NAFO, CEM, 2008a.

It was recognized that NAFO could consider concrete steps to identify and protect sensitive areas when incorporating the EBAFM within the NRA. It would require that advice from the SC be sought with regard to specific criteria for identifying such areas, as well as the identification of such areas pursuant to the established criteria. It was also recommended that NAFO develop a process to seek additional information on seamounts within the NRA. So, as an initial response to implementing an ecosystem approach, NAFO took important first steps to protect sensitive areas. The fishing ban imposed on

four seamounts in the NRA continued and in the subsequent year, the expansion continued to not only to include seamounts, but coral regions as well. A region of the Grand Banks was designated as a coral protection zone and would remain closed to bottom fisheries, employing the same logic used for the seamount closures. NAFO then launched a four-year coral monitoring and research program to set in motion an effective coral protection strategy (NAFO, 2007b).

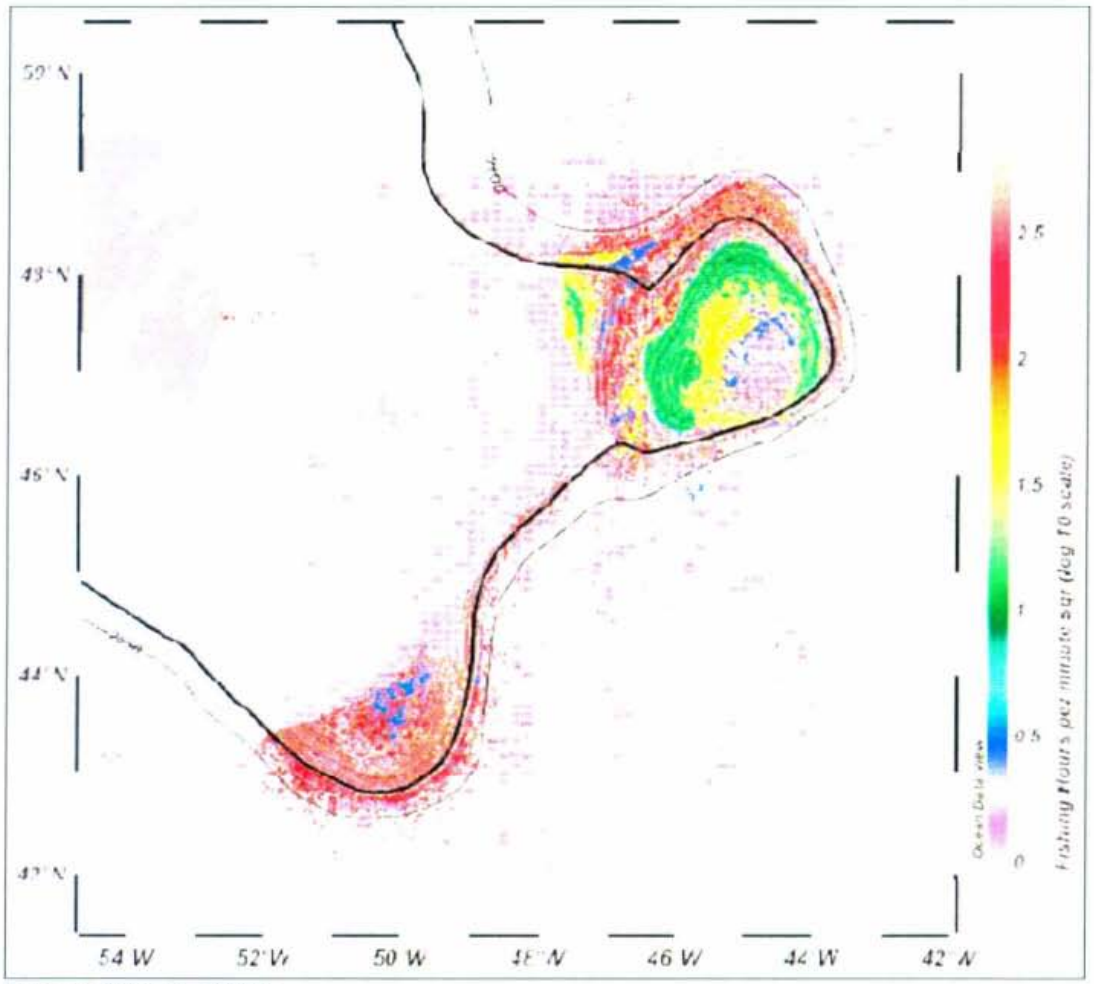
At the NAFO Annual Meeting in 2010, Contracting Parties expanded from the original four seamount closures and agreed to the closure of a total of six seamounts in the NRA (Figure 4.2), as well as the establishment of a permanent (was ad hoc previously) NAFO Working Group on Vulnerable Marine Ecosystems that will continue to provide advice to the NAFO FC (DFO, 2010).


Vulnerable Marine Ecosystems
Distinctive Bathymetric Feature
Écosystèmes marins vulnérables
Caractéristiques associées à la bathymétrie

seamounts, cold water corals, sponges and hydrothermal vents fit the criteria (NAFO, 2007). New additions and classifications for VMEs are actively being sought by Contracting Parties for NAFO. Various non-governmental organizations (NGOs), such as the World Wildlife Fund and other environmental management stakeholders, are working together with NAFO to try to reach a compromise on such ecosystem-based fisheries management issues and sustainability.

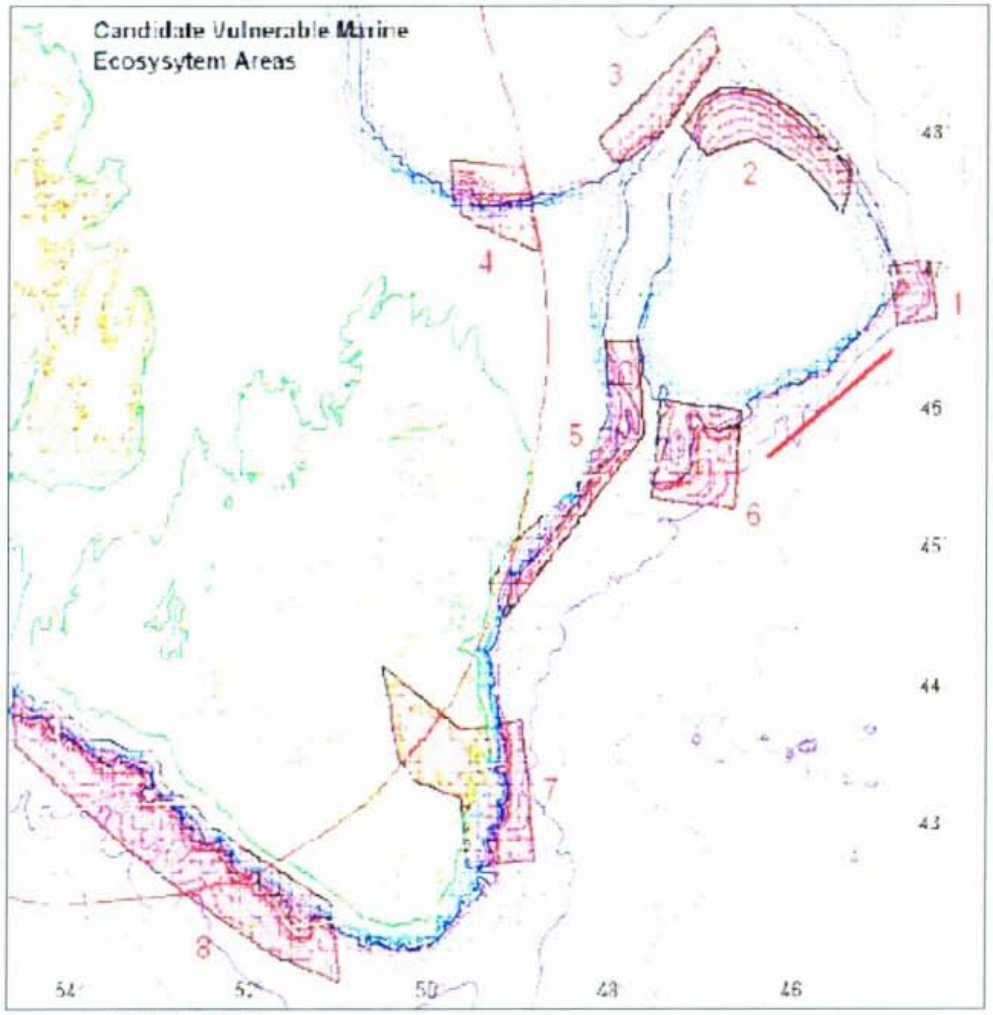
The identification of VMEs, like NAFO's commitment to the EBAFM, is an ongoing process. A number of working groups, methods and meetings have been established to achieve these dynamic commitments. In 2008, at an inter-sessional meeting in Montreal, NAFO held a discussion on a number of agenda items and VMEs formed a major part of that discussion. It was proposed that NAFO, with the help of its Contracting Parties, map existing fishing areas, a "footprint," (by 1 January 2009) in an effort to identify existing VME areas within the NRA. By mapping existing fishing areas, NAFO and its Contracting Parties would isolate and create a geographical representation of current fishing areas where VMEs would be catalogued and identified. In order to accomplish this feat, Contracting Parties would provide NAFO with information on bottom fishing for the reference period of 1987 to 2007 (Figure 4.3). This information would be provided to NAFO vis-à-vis VMS, and other geo-referenced data in more recent years where the technology was available, and through catch reports submitted by the Contracting Parties to NAFO. The areas highlighted by the footprint in the NRA would serve as "existing bottom fishing areas" and areas which are undefined would serve as

"new fishing areas" in which fishing efforts will be expanded to include identifying VMEs in these new areas. This is a strategy adopted by NAFO to identify and further monitor other potential VMEs within the NRA (Figure 4.4) based on similar characteristics. Sponges have since been the newest inclusion to the potential VMEs.



Source: NAFO, 2008b.

Figure 4.3: Existing NAFO Bottom Fishing Areas as of September 2008. Overlaid fishing positions and/or areas from 1987 to 2007 submitted by NAFO Contracting Parties as geo-referenced information by September 2008. Also included is information from the NAFO Vessel Monitoring System (2003-2007).



Source: NAFO, 2008c.

Figure 4.4: Candidate VMEs in NRA, As Indicated by the Highlighted Regions. These are the general areas of known VMEs with some overlap into the Canadian EEZ. The red line depicts an area where potential VMEs for deep-water coral were thought likely.

In an attempt to further protect VMEs, NAFO proposed that no bottom fishing will be conducted in deep-sea areas below 2,000 metres and that areas currently closed to

commercial fisheries are to remain closed until a scientific assessment from exploratory fisheries are available.

The ongoing identification of VMEs and the assessment of bottom fishing on identified areas are aimed to support the development of appropriate scientific methods for the longer term monitoring of health of VMEs. This implies the FC will develop additional conservation measures focusing on ecosystem health to be introduced under NAFO's Conservation and Enforcement Measures (CEM). The insertion of Chapter 1 (Bottom Fisheries in the NRA) in the NAFO CEM is evident of these additional measures. The FC, in consultation with the SC, would be in charge of monitoring as well as following up on whether fishing vessels are compliant in these VME areas, in addition to the traditional list of vessel monitoring duties (NAFO, 2008b, Chapter 1 bis CEM).

These actions are NAFO's ongoing 2007 Convention commitment, as it attempts to incorporate and adapt the EBAFM. The most recent adaptation has come in the form of the creation of the Working Group on the Ecosystem Approach to Fisheries Management (WGEAFM). The Working Group's Terms of Reference state that the group is to:

- identify regional ecosystems within the NRA;
- make an inventory of current knowledge on the components of each regional ecosystem (i.e. physical oceanography, primary production, zooplankton and secondary production, bethos and large vertebrates, fish and fish assemblages, seabirds, marine mammals, turtles and fisheries);

- explore the feasibility of different tools (e.g. ecosystem indicators, modelling, etc) that could be used in management advice in the NRA; and,

- comment on necessary International Council for the Exploration of the Sea (ICES)/NAFO working groups on deep-water ecology's report on its relation to the NRA (NAFO, n.d.).

The caveat to the VME identification process is that it has to receive relevant information from all Contracting Parties. The Group also maps locations of potential and future VMEs by utilizing the fishing footprint methods, as indicated by the sample trawling coordinates. Coral and Sponge Identification guides have been established by the WGEAFM as well as a fishery data collection form for identifying species of corals and sponges while fishing in the NRA. These methods are used to further obtain information on VMEs. NAFO's commitment to the EBAFM is embodied through the WGEAFM and its Terms of Reference. The advice it provides to NAFO weighs heavily on any decisions the RFMO makes with regard to collective fisheries management decisions, as it is comprised of experts from Contracting Parties. NAFO utilizes VME information and monitors and gauges the effects of bottom fishing in the NRA to identify existing and other potential VMEs. This is also applied to all exploratory fisheries, as exploratory bottom fishing shall be considered in the evaluation of risks of the significant adverse impact on VMEs, in line with a precautionary approach. Unfortunately, this information is exclusive for these purposes only, and is not incorporated into quota and TAC settings.

Section 5.0: Case Study Two - The International Joint Commission and the International St. Croix River Watershed Board

5.1 The Boundary Waters Treaty

Many rivers and lakes are located and flow between the borders of the United States and Canada (Figure 5.1). This often results in transboundary and jurisdictional conflicts relating to the use and access to these water bodies. For example, in the late 1890s, farmers in northern Montana dug small canals to divert water from the St. Mary and Milk Rivers for irrigation purposes. This continued into the early 1900s as other small diversion projects, such as dams, were erected (Halliday, 2007). While these water diversion systems could function without problem during periods of high river flows, the inconsistent nature of the water supply in the region, together with the collective impact of the diversions, began to threaten the health of the watershed and cause heated disputes and protests between various water users on both sides of the border (Halliday, 2007).

Source: Adapted from IJC, 2009a.

Figure 5.1: Shared Canada/United States Watersheds.

Around the same time on the Niagara River, which forms the border between New York State and Ontario, there was growing demand for electricity due to continuous expansion of the area. The Niagara River watershed's potential for inexpensive hydroelectric power and the close proximity of rail and shipping routes made it a magnet for heavy industry and chemical manufacturing companies in the early 1900s (Environmental Protection Agency, n.d.). In the early years of this period of development, no regulations or legislation existed to deal with industrial waste that was dumped directly into the river system. It became evident that both countries needed to balance the growing demand for electric power with the interests of navigation, while safeguarding the natural beauty of the Niagara Falls (IJC, 2009a).

It was not until 1896 that motions to mitigate and solve these disputes were attempted. The Canadian government requested the British Ambassador at Washington inform the American government that it was prepared to cooperate only by "appointment of an international Commission or otherwise" in the regulation of international streams for irrigation purposes (IJC, 2009b). A response from the American government did not come until six years later in 1902, when President Roosevelt signed the *River and Harbors Act* (Evans, 1992). Under the terms of the Act, Roosevelt requested:

> "...to invite the government of Great Britain to join in the formation of an international Commission to be composed of three members from the United States and three who shall represent the interests of the Dominion of Canada, whose duty it shall be to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada, including all of the waters of the lakes and rivers whose natural outlet is by the River Saint Lawrence to the Atlantic Ocean, also upon the maintenance and regulation of suitable levels, and also upon the effect upon the shores of these waters and the structures thereon, and upon the interests of navigation by reason of the diversion of these waters from or change in their natural flow; and, further, to report upon the necessary measures to regulate such diversion, and to make such recommendations for improvements and regulations as shall best subserve the interests of navigation in the said waters..." (IJC, 2009b)

With acceptance from the British and Canadian governments, the International Waterway Commission was officially formed in 1905. This new Commission had very limited success as there was immediate hesitation on the protocol describing the investigation of procedures and water consumption. There was also confusion about the boundary waters that were included under the Commission's jurisdiction (IJC, 2009b). The Canadian government understood that all waters along the border were included, but the American government had understood that only the Great Lakes were supervised by the Commission. Also, the American understanding of the Commission was that if friction arose over such matters, the Canadian Commissioners were requested to side with them. It was apparent that the Commission was losing its relevance; however, it did recommend the establishment of principles to govern the use and diversion of boundary waters and the creation of a permanent body with wider powers (IJC, 2009b). Only two years later, negotiations for a new treaty began in Washington.

On 11 January 1909, the *Boundary Waters Treaty* was signed. The Treaty contained 14 Articles pertaining to various issues of navigation, water flow, pollution and all shared waters from Pacific to Atlantic coasts. More importantly, under Article VII, the IJC was established:

> "The High Contracting Parties agree to establish and maintain an International Joint Commission of the Untied States and Canada composed of six Commissioners, three on the part of the United States appointed by the President thereof, and three on the part of the United Kingdom appointed by His Majesty on the recommendation of the Governor in Council of the Dominion of Canada." (IJC, 2009c, Article VII, Boundary Waters Treaty)

Under the United States Constitution, the Treaty has been incorporated into U.S. law, and Canada confirmed the Treaty in the *International Boundary Waters Treaty Act*, passed in 1911.

The clarity and simplicity of the Treaty provides general principles, rather than detailed prescriptions, to guide the two countries in matters such as approving dams that would affect natural water levels or flows across the boundary (IJC, 2009a).

5.2 International Joint Commission

5.2.1 Organization, Roles and Responsibilities

As mentioned under Article VII of the *Boundary Waters Treaty*, Canada and the United States appoint six IJC Commissioners, three representatives from each country, including

one chair. The highest level of government from each respective country individually selects these Commissioners. In the United States, the President, with the approval from the Senate, selects its representatives and in Canada, the Governor in Council, on advice from the Prime Minister, selects its representatives. Once appointed, they do not represent the national governments, but operate at arm's length[8] (IJC, 2009a).

The IJC is a bi-national organization and quasi-judicial body that assists both governments in finding solutions to problems caused by competing interests on transboundary waters (IJC, 2009a). Throughout its existence, the IJC has evolved and maintained its functionality through the auspices of the *Boundary Waters Treaty* and has also been adaptable to take on additional responsibilities of other agreements that were signed between the two countries. These agreements have expanded the roles and responsibilities of the IJC. In general, the IJC ensures that all shared waters and airspace along the border are utilized according to the *Boundary Waters Treaty 1909, Great Lakes Water Quality Agreement 1978,* and *Air Quality Agreement 1991.*

When requested by the national governments, the IJC, as instructed in the Treaty, must study and recommend solutions to transboundary issues. These requests are called "references" and usually focus on water and air quality, along with other issues related to

[8] The Commissioners must follow the Treaty as they try to prevent or resolve disputes. They must act impartially, in reviewing problems and deciding on issues, rather than representing the views of their respective governments.

the development and use of shared water resources (IJC, 2009a). The IJC has carried out its duties to these references through a variety of mechanisms. Such mechanisms include deciding on approval for applications of projects such as dams, diversions or bridges that would affect the natural level or flow of boundary waters, or dams on transboundary water systems that would raise the level. Of course when doing so, the IJC considers interests in both countries in accordance with the Treaty.

The IJC also appoints boards consisting of equal numbers of experts from each country when dealing with references. Members jointly establish the facts in a professional capacity and act impartially, just as the IJC itself operates. The boards provide advice and recommendations on each reference in an advisory role only (IJC, 2009a). The Treaty also requires that the IJC listen to the views of all interested parties when dealing with references. This is usually done through public hearings or meetings; however, it may also involve public participation on boards through the appointment of certain stakeholders. Some references may result in a continuing role for the IJC, such as monitoring compliance in certain watersheds with international water quality objectives or other transboundary issues of concern. The IJC receives regular reports from its boards to help fulfill these ongoing commitments and responsibilities.

In the past, transboundary water issues were often seen as problems that were specific to a single factor, like a dam or certain pollution sources, in isolation from other factors

(IJC, n.d). The IJC has acknowledged the best way to manage such issues is through an ecosystem-based approach that manages using an integrative and holistic ideology that stems from the collective principles of the *Boundary Waters Treaty*. This ecosystem-based approach has been coined the IWI by the IJC.

5.2.2 International Watersheds Initiative

Over the past decade, the IJC has been developing the IWI, which is supported by special funding from the American and Canadian federal governments. The underlying premise of the IWI is that water resource and environmental problems can be anticipated, prevented or resolved at the local level before developing into international issues (IJC, 2008). To accomplish this goal, an integrated ecosystem approach that looks at complex interactions and interrelationships in entire watersheds was suggested. This was the result of many consultations with federal, state and provincial governments, tribes and First Nations, and other communities who utilize transboundary watersheds (IJC, 2008). The integrated ecosystem approach that these consultations agreed upon was:

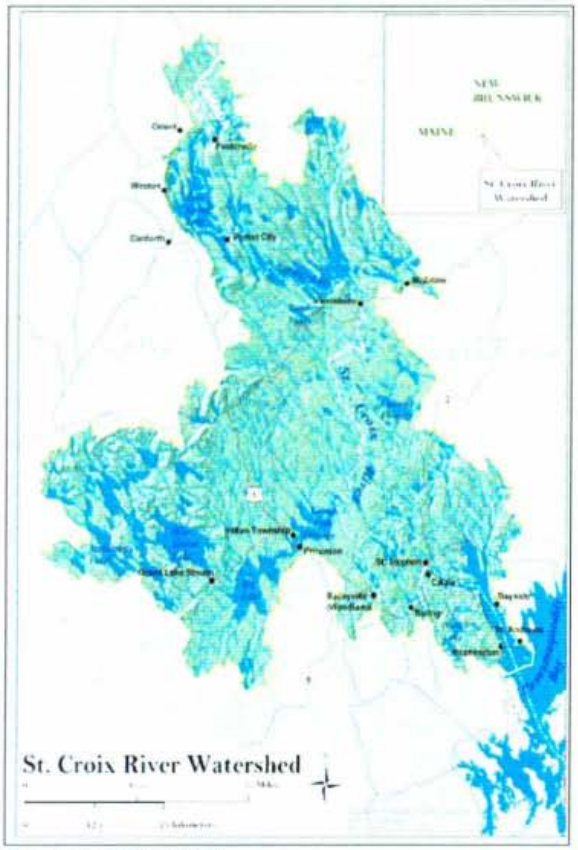
> "…an integrated approach that considers the entire range of goods and services that can be derived from the environment and that attempts to maximize the mix of benefits. It recognizes that ecosystems function as whole entities and should be managed as such, looking beyond traditional jurisdictional boundaries. It takes a long-term view, considering impacts and benefits as they play out over decades and affect future generations…" (IJC, 2009d)

Several watersheds were selected as pilot areas to test out the new initiative nationwide for both countries. The first watershed selected was the St. Croix River watershed in

Maine and New Brunswick, which was administered by the ISCRWB. In April 2007, it became the first designated IWI board of the IJC.

5.3 International St. Croix River Watershed Board

The St. Croix River forms 185 km of the international boundary between Canada and the United States, dividing Maine and New Brunswick, and its watershed (Figure 5.2) covers an area of 4,230 km^2. The river plays an integral role in the lives of people who sparsely populate the area, as the economy is based largely on natural resources and tourism that the river and watershed provides. The waters are utilized for forestry, pulp and paper, fisheries, recreational activities, hydro-electric power, and municipal and industrial water supply.



Source: IJC, 2008

Figure 5.2: St. Croix River Watershed.

In the past, the IJC had two separate boards for managing activities in the St. Croix River watershed: the International St. Croix River Board and the International Advisory Board on Pollution Control - St. Croix River. The first board was established in 1915 and dealt with the construction of dams and regulation of water levels and flows within the area. The second was created in 1962 and it reported on municipal and industrial pollution, as well as water quality (IJC, n.d). The two boards operated separately, but because of the close cooperation between the two boards, the IJC combined them in 2000 to create a

single, more efficient and inclusive board, the International St. Croix River Board (IJC, n.d.). After the announcement of the IWI by the IJC, the board was designated the first formal IJC international watershed board in April 2007. Since the IWI designation, it has been known as the ISCRWB. The functions of the ISCRWB are to help prevent and resolve disputes over the boundary waters of the St. Croix River, monitor the ecological health of the waters, and ensure that four dams comply with the Commission's Orders of Approval.

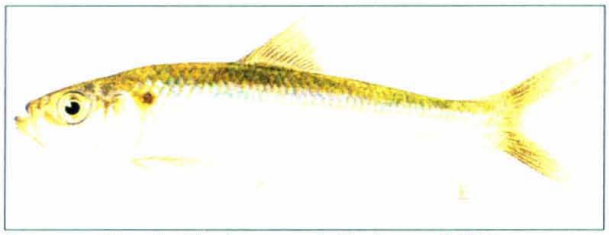
The ISCRWB is currently involved in a number of issues with the watershed. These include protecting the watershed from municipal wastewater and stormwater discharges, industrial pollutants, and agricultural runoff (IJC, 2005). Also, because of increased water-use interests such as recreation, industry, new fisheries, and Aboriginal use, both old and new conflicts continue to surface as various water users compete for water and the uses it provides. The most significant issue in the watershed remains a longstanding, unsolved dispute - the on-going competing interests of smallmouth bass fishing and the restoration of a native fish species, the alewife (IJC, 2005). One of the tasks of the board involves providing watershed stakeholders with unbiased, scientific information and advice concerning this dispute. The main focus is on the conflict between anglers and lodge owners searching for financial security versus scientists and other stakeholders seeking to restore the natural ecology of the area.

5.3.1 Alewife and Smallmouth Bass Importance in the St. Croix River Watershed

Alewife (*Alosa pseudoharengus*), commonly known as gaspereau (Figure 5.3), inhabit the St. Croix River watershed. The alewife is an anadromous fish native to the St. Croix River that has a repeat spawning history within the watershed (Flagg, 2007). They have an ecological role in food webs and nutrient cycles of marine, freshwater and terrestrial ecosystems. Alewives do this by releasing nutrients into the freshwater ecosystem through their eggs, excretion and decaying bodies. The abundant alewife runs provide a major food source for other fish and bird species, like osprey, hawks, and eagles (Maine Department of Marine Resources (DMR), 2008), making it an important component of the food web for the watershed. Alewives also act as the only host for fresh water mussels (alewife floaters) that help to naturally filter water (Nedeau, 2003). The larvae of freshwater mussels are released by females into the water, where they must find a suitable host fish and attach to its fins or gills. These mussels are often specific about the fish they can parasitize. These freshwater mussels inhabit large permanent water bodies throughout North America and are considered critically endangered as 75% of the 297 species are officially listed as Special Concern, Threatened or Endangered by the American Fisheries Society, The Nature Conservancy, the Committee on the Status of Endangered Wildlife in Canada and also federal fisheries and wildlife departments under the *Endangered Species Act* (Nedeau, 2003).

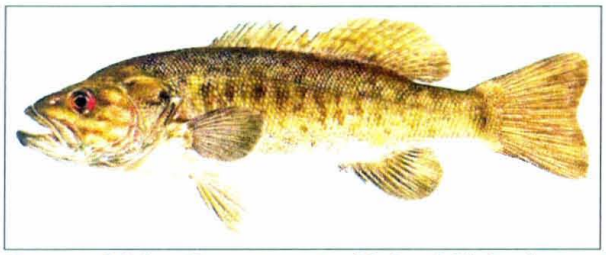
Aside from the alewife being ecologically significant to the watershed, the lobster fishing industry also depends on the health of the alewife. Traditionally, lobster fishers have used

adult alewives as preferred bait for their lobster traps because it attracts lobster (DMR, 2008). It became a cheap and effective baitfish because of its abundance, thus making it a staple for the industry.



Source: Kraft, Carlson and Carlson, 2006.
Figure 5.3: Alewife (*Alosa pseudoharengus*).

Smallmouth bass (*Micropterus dolomieui*) (Figure 5.4) also inhabit the St. Croix River watershed. It is an introduced species that was stocked in the lake system in 1877. By the early 1900s, the population had expanded to the extent that the ecology in many parts of the watershed was altered because it was not an indigenous species (Watson, 1965; Warner 2005). Since their introduction, smallmouth bass has provided an attractive and lucrative sport fishing industry for the area, employing many local guides and anglers.



Source: Maine Department of Inland Fisheries and Wildlife, 2010
Figure 5.4: Smallmouth Bass (*Micropterus dolomieui*).

The anglers and guides who financially depend on the sport fishing and tourism industry need a healthy and thriving smallmouth bass population. The smallmouth bass is deemed a prized sport fish that avid anglers pay a lot of money to catch. This includes paying for amenities such as guided boat tours within the watershed, lodging, meals and other expenses associated with gaining the perfect fishing experience. As a result, a pro-bass attitude is embedded in these watershed users, as the fish is essential to their livelihoods.

5.3.2 Alewife-Smallmouth Bass Conflict

Historically, it was reported that alewife numbers were so great that they could never be destroyed. The St. Croix River and the tributaries in its watershed offer the perfect breeding ground for a great number of alewives (Perley 1852, Atkins 1887). Erected dams (Figure 5.5) and water pollution drastically reduced the number of spawning runs for the alewife in the 1860s.

Source: Dill *et al.*, 2010

Figure 5.5: Selected Cities and Dams within the St. Croix River Watershed.

During the early 1980s, improved fish passage in the dams and water quality in the watershed rejuvenated the alewife population. Coincidentally, with the alewife rejuvenation, there was a drastic reduction in juvenile smallmouth bass numbers, and smallmouth bass angling was at an all time low. The anglers and guides of the area perceived the dwindling population of smallmouth bass to be directly associated to the return of the alewife. Many unconventional and unsuccessful management measures were used to address the decline, but these measures did not solve the dwindling smallmouth bass population. Instead, these measures contributed greatly to drastically reducing the alewife population in the watershed. These measures were:

- Alewives were blocked from entering Spednic Lake in 1987;

- In 1991, American and Canadian fishing agencies began an alewife assessment in the lower St. Croix watershed by temporarily blocking alewife passage to Grand Falls Dam;

- Guides were successful in lobbying the Maine Legislature to pass a bill to shut down the fishways at the Woodland and Grand Falls dams to prevent alewives from swimming upstream to their spawning grounds in the watershed.[9] This action took place in 1995 and decimated the alewife population as the stock declined from over 2 million returning alewives to only 900 in 2002 (St. Croix International Waterway Commission, 2009).

- In 2001, efforts to overturn the alewife blockage law failed, so the Department of Fisheries and Oceans (DFO) began a repopulation effort by capturing, trucking and releasing alewives upstream.

Due to yielding mostly unwelcomed results and no consensus from the different ad hoc management measures, the ever growing conflict, and the continued decline of alewives and smallmouth bass, two independent studies by the Maine Rivers Organization were conducted in an attempt to answer/address the alewife and smallmouth bass interaction. The studies concluded that anadromous alewives caused no harm to the smallmouth bass. In fact, juvenile alewives are a food source for small mouth bass. The study also suggested that the low number of smallmouth bass was affected by a number of factors, all environmental. These included fluctuations in water temperature, water levels, food availability, and predators (Maine Rivers, 2006).

[9] 12 Maine Revised Statutes §6134, 1995. Accessed at http://www.mainelegislature.org/legis/statutes/12/title12sec6134.html

As a result of the Maine Rivers study, both the IJC and the ISCRWB decided to accept the findings. However, the conflict still remained between the pro-bass and pro-alewife parties, and the Maine 1995 Legislature still prevented alewife access upstream.

5.3.3 Adaptive Management Plan

In an attempt to follow IWI protocol and to look after the ecological integrity of the entire watershed, the IJC and ISCRWB asked the St. Croix Fisheries Steering Committee, a bi-national inter-agency, to propose an adaptive plan to manage reopening of the watershed to alewives. The proposed plan would involve crucial stakeholder engagement from federal, provincial and state agencies, watershed users, anglers, guides, and the general public before implementation. The plan is to offer a solution to restore a self-sustaining alewife population, and maintain the smallmouth bass fishery at current or higher levels (Dill et al., 2010).

The proposed draft adaptive plan involves reinstalling fishways that allow, rather than block, both upstream and downstream passage, and the dismantling of dams. Pollution prevention controls and minimum water flows are also utilized. The plan's implementation would require unrestricted alewife passage at both the Woodland and Grand Falls dams, despite the Maine Legislature's effort to block the species (Dill et al., 2010). Also, great care has been taken to protect the sport fishery as alewives are reintroduced in the system. Spednic Lake, Grand Lake, and all points upstream of them,

have been excluded from the area being reopened to the alewives (Dill et al., 2010). Furthermore, one-third of the alewife's estimated natural spawning habitat will eventually be reopened.

The plan was completed and submitted to the ISCRWB, and it was decided that the draft would be released for general public review and comment. This comment period was held 16 June - 17 September 2010. The plan received much feedback, most of it concerned with the health of the alewife in the watershed, and suggestions that alewives be allowed in the whole watershed without any restrictions or monitoring conditions (IJC, 2010). Revisions have been made to the adaptive management plan and it has been submitted to the ISCRWB and IJC for its consideration and possible future action.

Section 6.0: Discussion and Conclusions

6.1 Summary

This study was undertaken to establish how the EBAFM originated and evolved to complement, but not replace, traditional single-species focused methods. Single-species approaches do provide fundamental data and science that are essential for fisheries management. However, traditionally, the sole reliance on single-species management has been too narrowly focused and has often ignored other factors that directly and indirectly affect the status of a particular fish stock (e.g. ecosystems and environmental factors). This reliance on a single-species method has resulted in failed fisheries management practices, prompting the development of a more holistic and inclusive method, where everything is interconnected – the ecosystem approach.

The concept of an ecosystem approach to resource management was first mentioned to an international audience in 1971 at the Ramsar Convention. Through subsequent key events, as well as international gatherings, conventions, and international customary law that followed Ramsar, nations and RFMOs are now incorporating the ecosystem approach and it is figuring more prominently in the management of fisheries throughout the world. RFMOs are adopting ecosystem concepts in their planning and decision making processes, or at least in spirit, in their communications and administrative protocols. The application of the approach itself remains difficult and dubious, due to the complexity of systems and the concatenations; there is no one-size-fits-all approach. This often results in differing applications by these management bodies.

This paper utilized two case studies to show how the ecosystem approach has been adopted and embedded into management protocol of two fisheries management bodies - NAFO and the IJC's ISCRWB. Both now utilize the EBAFM, but to do so, these entities had to adapt and re-think their respective traditional management styles. They had to evolve and incorporate factors and linkages found within the environment. NAFO and the ISCRWB also considered stakeholders to complement their single-species approaches in order to form more holistic management styles. However, much work remains to be done.

The two case studies illustrate how each entity developed its own version of the ecosystem approach, with NAFO utilizing VMEs. NAFO's focus on VMEs included identifying important habitats for fish species. This resulted in the identification of various VMEs - sponges, corals and seamounts - and eventual closure of certain VMEs to bottom fishing. NAFO's ecosystem approach is encapsulated through its WGEAFM and WGEAFM's Terms of Reference focusing on VMEs. This application of the EBAFM has expanded NAFO's portfolio and capabilities to better position itself in managing fish stocks within the NRA. Nevertheless, willingness from associated Contracting Parties is needed to expand closures of VMEs to areas that are subject to heavy commercial fishing.

The IJC and its ISCRWB utilized the ecosystem approach through the IWI. This initiative became more encompassing than NAFO, as the IWI focused predominantly on

stakeholder engagement and incorporating the ecology of the watershed as a whole. The IWI has been utilized for various conflicts within the St. Croix River watershed, but focus was on the management of the alewife and reintroducing the species back into its natural habitat. The ecosystem approach in this scenario is to balance both the ecological integrity and socio-economics of the watershed through an adaptive management plan.

6.2 Contrarian Point of View

The urgent need to reduce the constant pressures put on the world's water systems and oceans from over-fishing is now widely recognized. However, there is less agreement over the exact levels to which fishing mortality must be reduced in order to lessen the indirect effects of fishing, while ensuring the future sustainability of catches, as well as the health of marine ecosystems. The ineffectiveness and sole reliance on conventional management strategies, such as single-species management, has allowed the EBAFM to become widely adopted by institutions charged with the mandate of stewardship and protection of the marine environment. But, within the ecosystem approach itself, there is also disagreement over whether this particular approach truly represents alternatives that will be any more effective than historical practices (Browman et al., 2004).

Hilborn (2004) contests that many papers have been published in high-profile journals that attribute the role of fishing to the collapse of marine ecosystems, the destruction of marine habitats, and changes in marine ecosystems that could result in possible future

collapse of fisheries depending on these ecosystems. Due to these publications, it is believed that the conventional single-species management approach has failed and new approaches are desperately needed, namely a shift from single-species fisheries management to an EBAFM. The specific proposed solutions that emerge from this literature about the EBAFM are:

1. The elimination of subsidies for fishing fleets;
2. Reduction of target fishing mortalities;
3. Protecting a significant portion (20-30%) of the world's marine areas from fishing activity in the form of Marine Protected Areas (MPAs) and;
4. The elimination of destructive fishing practices (bottom trawling) (Hilborn, 2004).

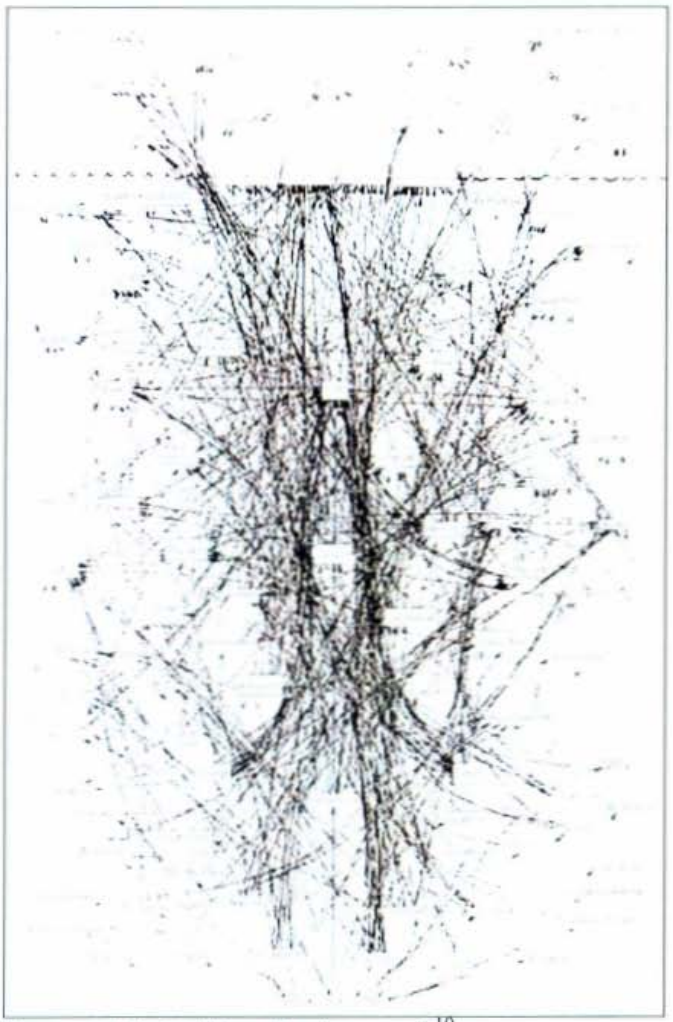
Differing viewpoints on the status of fish stocks are also apparent. There are some scientists, like Worm et al. (2006), who concluded from their research that the majority of global fish stocks have collapsed years ago and will most likely never recover. They are also boldly predicting that the all global fish stocks could collapse by 2048. Daniel Pauly (2007) also sided with Worm et al. (2006) and insisted that 70% of the world's fish stocks are overfished or collapsed and that the rate of overfishing is accelerating. However, catch data relating to some global fisheries actually show increasing yields and prove this to be untrue (FAO, 2009). Additionally, Worm, Hilborn, and colleagues conducted a groundbreaking survey of 10 marine ecosystems across the globe in 2009. This survey found that in areas where rates of fishing had been reduced, even collapsed

fish stocks could revive and become commercially viable again. However, this survey cautioned that 63% of the assessed fish stocks need rebuilding (Worm et al., 2009). This was encouraging news, realizing that proper fisheries management methods, like the ecosystem approach, may be successful when applied properly.

The contention between scientific literature on ecosystem-based management and its applications to fisheries is widely debated. The term "ecosystem" means different things to different authors. The abundance of papers, journal articles, and books written on ecosystem management is in wide variety, stemming from many different disciplines. Where does one even begin to start? The major disagreements over possible solutions are not so much where we would like to be, but how to get there.

Again, looking back at the definition of an ecosystem from the 1992 Convention on CBD, it utilizes the words "dynamic" and "complex." When varying management approaches are incorporated into the dynamics and complexities of different ecosystems and food webs (Figure 6.1), at what point do we begin to narrow down specific aspects? Even if that point is attained, then what resources will be allocated to fully understand these direct and indirect interconnections between multiple species at different trophic levels? The scientific challenges are evident when trying to answer these questions. When these challenges are combined with the social aspect of ecosystems, will there ever be such a thing as equilibrium in an ecosystem? By the time we begin to understand even

a microcosm of an ecosystem, it changes. These are the daunting tasks when trying to develop such an approach to managing resources, especially when it is something as dynamic and complex as fisheries.



Source: Adapted from Lavigne, n.d.[10]

Figure 6.1: A "Simplified" Food Web of the Northwest Atlantic in Relation to the Dynamics and Complexity of Ecosystems.

[10] Accessed at http://www.visualcomplexity.com/vc/images/47_big02.jpg

Understanding the difficult nature of applying an ecosystem approach to managing fisheries, NAFO has focused on VMEs and the ISCRWB on smallmouth bass-alewife interactions in an attempt to incorporate a type of ecosystem approach to its management efforts. By identifying and applying these ecosystem approach methods, despite it being a microcosm of the ecosystem approach, it is at least a starting point and shows how the ecosystem approach can be adapted and utilized.

6.3 Conclusions

The information provided in this report alludes to a probable starting point, and how it developed as a systematic approach to fisheries management. This report shows that, contrary to some views, changes in fisheries management strategies do occur. This change originates at the international level as aspirations and platitudes, tends to be poorly defined and non-committal in the first instance, and goes through several iterations over decadal time frames before becoming accepted practice of the global community. Examining and analysing international mechanisms and frameworks is the best way to identify the leading edge of change, as global governing bodies seek consensus in the way they manage common resources. Through successive agreements and Conventions, one can see how the EBAFM emerged, evolved and matured to the point where an overwhelming concentration of money, expertise and resources are applied to it today.

The EBAFM is still relatively new and evolving. To meet the ongoing commitment to this approach, this paper purports that RFMOs are most likely the best governing bodies, with sufficient capacity in the short-term to implement it. NAFO has committed significant research and resources to this ongoing commitment and reforming its method of operation. It will be interesting to see what the future holds for the EBAFM and how (or if) VMEs evolve as an integral part. Will NAFO continue to close areas to bottom fishing? Is it that RFMOs feel they have to act on closed areas, however meaningless or unrepresentative/unimportant these areas may be in an ecosystem context, simply to quiet criticism from external observers and at home?

In regards to the IWI and the adaptive management plan, it remains to be seen how this new management strategy will impact the ecology of the St. Croix waterway. The ongoing dispute between the alewife and smallmouth bass protagonists is an example of how social, economic and environmental needs conflict with each another. In this case, those connected to recreational and sport fisheries are opposed to alewives. However, scientists, lobster fishermen, and other stakeholders present perhaps a broader view of the role a species plays in an ecosystem. As the economy declines and research sheds more light on the matter, priorities may shift again, leading to greater frustration and conflict on both sides. Communities in the St. Croix watershed have a number of stakeholders who could become disgruntled about the state of the waterway, especially if pollution prevention and other controls are too strict (preventing economic activity) or not strict enough. The IJC and the ISCRWB should be prepared to respond to intense criticism

voiced by various stakeholders, and consider ways to balance interests that are equally important yet in direct competition. A belief that is shared by many authors is that we need a form of ecosystem management that emphasizes the interaction between fish, fishermen and government regulators, while concentrating on incentives and participation with user groups.

The application of the EBAFM has been elevated internationally as a biological, economic, and political imperative to avert catastrophic collapse of fish resources, but even the experts do not truly understand what this application entails. The general principles seem to be covered, but the multiple interpretations and confused expectations from government management agencies, management organizations, expert stakeholders, deep environmentalists, and non-profit organizations have yet to converge on what constitutes a common EBAFM. Where should the effort be concentrated and what is the end game? This is notwithstanding the biological interactions between trophic levels, how biotic and abiotic factors interplay, and the attendant information demands. Any practical development and application of this management approach remains a work in progress. Perceived past fishery failures are sometimes judged by whether or not a single-species or ecosystem approach was utilized, but it may simply be a function of removal rates that were clearly unsustainable. This could be highlighted through the groundfish collapse in Atlantic Canada, where in retrospect, overestimation of fish stocks by Canada and NAFO, along with the alarming exploitation rates of domestic and foreign vessels, appeared to have decimated these stocks (irrespective of what was happening in the

macro and micro environments). Nonetheless, biological and social complexity of ecosystems and the real risk of resource depletion make the ecosystem based approach impossible to ignore and its adaptation and interpretation by entities like NAFO and the ISCRWB provide possible viable starting points.

There is not one uniform ecosystem-based approach, but many. However, the concept of protecting the ecosystem as a whole by using traditional management techniques like single-species approaches, coupled with the EBAFM, will remain essential. Although these approaches have both limitations and appropriate applications, the EBAFM should be expected to complement, not replace traditional management techniques.

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