The Integration of Full-spectrum Ecosystem-based Management in Canadian Fisheries Management Plans

Stacey D. Paul and Robert L. Stephenson

Fisheries and Oceans Canada
Science Branch, Maritimes Region
St. Andrews Biological Station
125 Marine Science Drive
St. Andrews, NB E5B 0E4

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By

Stacey D. Paul[a] and Robert L. Stephenson[a,b]

[a] Fisheries and Oceans Canada
Science Branch, Maritimes Region
St. Andrews Biological Station
125 Marine Science Drive, St. Andrews, NB E5B 0E4

[b] Canadian Fisheries Research Network
Department of Biology, University of New Brunswick
20 Bailey Drive, Fredericton, NB E3B 5A3

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TABLE OF CONTENTS

ABSTRACT

Paul, S.D. and Stephenson, R.L. 2020. The integration of full-spectrum ecosystem-based management in Canadian fisheries management plans. Can. Tech. Rep. Fish. Aquat. Sci. 3350: v + 16 p.

Ecosystem-based management requires consideration of full-spectrum sustainability, with explicit consideration of ecological, economic, social/cultural and institutional objectives. This paper examined the scope of considerations in 17 fisheries management plans across Canada in comparison to a new comprehensive evaluation framework for full-spectrum sustainability proposed by the Canadian Research Fisheries Network. There is a gradient in the amount and specificity of objectives, information and analysis in Integrated Fisheries Management Plans (IFMPs) in Canada. Ecological aspects, including productivity, biodiversity and habitat, were considered with explicit objectives and analysis in all IFMPs. Economic considerations varied among plans. Objectives related to viability and prosperity of fishing operations were more prevalent and more specific; economic benefits to communities were often present but aspirational, and there was little explicit attention to employment and trading relationships. Social and cultural considerations were weakest. Apart from a widespread objective reflecting Aboriginal Rights (in all plans) most other considerations were vague, and there was very little evidence of information relating to aspects including community well-being and adaptive/social capacity. Implementation of a comprehensive ecosystem approach that includes integration of ecological, economic, social/cultural and institutional objectives requires a) development of data sources for neglected elements, b) improved capacity for interdisciplinary considerations, and c) development of process(es) for review, evaluation and development of advice for full-spectrum sustainability.

RÉSUMÉ

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La gestion écosystémique requiert la prise en compte du spectre complet de la durabilité, ainsi que l'examen explicite des objectifs écologiques, économiques, sociaux, culturels et institutionnels établis. Cette étude se penche sur la portée des considérations exposées dans 17 plans de gestion des pêches mis en place dans l'ensemble Canada, en comparaison avec un nouveau cadre d'évaluation détaillé établi pour le spectre complet de la durabilité qui a été proposé par le Réseau canadien de recherche sur la pêche. Une variation est observée en ce qui a trait à la quantité et à la spécificité des objectifs, des analyses et des renseignements présentés dans les plans de gestion intégrée des pêches au Canada. Certains aspects écologiques, comme la productivité, la biodiversité et l'habitat, ont été examinés à l'aide d'objectifs et d'analyses explicites dans tous les plans de gestion intégrée des pêches. L'étude des facteurs économiques a quant à elle varié d'un plan à l'autre. Les objectifs liés à la viabilité et à la prospérité des activités de pêche étaient plus nombreux et plus précis, les avantages économiques pour les collectivités étaient souvent tangibles, mais ambitieux, et peu d'attention était explicitement accordée aux relations de travail et aux relations commerciales. Les facteurs sociaux et culturels, toutefois, étaient encore moins largement abordés. Outre un objectif répandu qui tient compte des droits autochtones (dans tous les plans), la plupart des considérations étaient vagues et il existait très peu de renseignements liés à certains facteurs comme le bien-être, la capacité sociale et la capacité d'adaptation des collectivités. La mise en œuvre d'une approche écosystémique complète qui englobe l'intégration des objectifs écologiques, économiques, sociaux, culturels et institutionnels exige a) la création de sources de données pour les éléments négligés, b) le renforcement de la capacité liée aux considérations interdisciplinaires, et c) la mise en place de processus pour la réalisation d'examens et d'évaluations, ainsi que pour la formulation de conseils à l'égard du spectre complet de la durabilité.

INTRODUCTION

Traditional fisheries management in Canada and around the world has been based primarily on quantitative examination of biological and fishery information relating to the productivity of single stocks of commercially exploited species (Gavaris 2009, Mace 2004). Despite substantial effort in stock assessment and significant advances in modelling and statistical analyses to aid fisheries management, many fish stocks around the globe have suffered declines or collapse, and the ability of fisheries resources to meet future human requirements is in question (Tittensor et al. 2014; Travis et al. 2014). Further, there has been increasing realization of the need for broader consideration of human impacts on the ecosystem and adoption of more holistic management approaches for sustainable fisheries (Stephenson 2012, Liu et al. 2015, Essington et al. 2015). This has contributed to the increasing popularity of ecosystem-based management approaches, which aim to improve sustainable delivery of a broad suite of ecosystem services from the ocean (Fogarty and McCarthy 2014, Long et al. 2015, Smith et al. 2017).

Driven by international agreements and conventions, Canada's Oceans Act (Canada 1997) provided the legislative basis for a broader, more holistic ecosystem-based management (also known as Ecosystem Approach to Management, or EAM) and changed the way in which oceans and their resources were to be managed. In 2008, the Federal Sustainable Development Act (Canada 2008) further supported a holistic outlook by acknowledging the need to integrate environmental, economic and social factors in all federal decision-making processes. While there are diverse definitions of an ecosystem-based approach (Long et at. 2015), it is increasingly recognized that EAM requires that oceans are managed collaboratively with stakeholders and that there is consideration of the ecological, economic, social/cultural and institutional/governance aspects of all activities in marine resource management plans (e.g. Kooiman et al. 2005, Link et al. 2010, Fogarty and McCarthy 2014, Marshall et al. 2018).

Although EAM principles and supporting legislation have been in place for some time, the implementation of EAM is still in development (Curran et al. 2012, Begg et al. 2014,2015, Levin et al. 2018). The evolution of management planning to a more comprehensive, holistic and 'full-spectrum' perspective of sustainability (Foley et al. 2019) requires new tools and methodologies, new and different kinds of information and an interdisciplinary approach (Stephenson et al. 2017). The concept of inter-disciplinarity has been slow to develop in fisheries (Phillipson & Symes 2013); however, it is essential when considering the range of issues and complexities in management of fisheries, which are social-ecological systems (Charles 1995, Perry et al. 2011).

It is clear that a wider consideration of social-ecological processes presents new challenges, including the availability of data to support the additional considerations. Rothschild and Beamish (2009) suggested that 'new mantras' of management (including managing ecosystems, managing habitat, ending overfishing, using the precautionary approach and rebuilding stocks) have resulted in new data requirements. Stringer et al. (2009) claimed that this phenomenon has stretched the capacity of fisheries science to respond to the growing array of information requests that are now considered necessary to make responsible decisions. Further, EAM requires more participatory governance regimes in which there is an expectation that participants will contribute knowledge and participate actively in governance (Kooimann et al. 2005, Fanning et al. 2011, Stephenson et al. 2016). These requirements and restrictions collectively lead to an information challenge and the questions of 1) what information, if we had it, would have the greatest positive impact on management? and 2) how can that information be provided?

In this paper, we examine fisheries management plans across Canada in light of the types of information that are used to fulfill the requirements of EAM objectives by Fisheries and Oceans Canada (DFO). We compare the current data and management objectives to a new comprehensive evaluation framework for full-spectrum sustainability proposed by the Canadian Research Fisheries Network (CFRN) (Stephenson et al. 2018, 2019a). We then consider where there are gaps in information as a measure of evaluating the degree to which the EAM has been operationalized in Canadian fisheries management planning, and to suggest recommendations for improved implementation.

CONTEXT

INTEGRATED FISHERIES MANAGEMENT PLANNING

Canada's Sustainable Fisheries Framework (SFF; DFO 2016) is an umbrella that provides the basis for fisheries conservation and sustainability by incorporating precautionary and ecosystem approaches into the decision-making process. The SFF is comprised of a number of policies, and initiatives, to support Canada's commitment to the principles of ecosystem-based fisheries management. The primary policy tool for the implementation of SFF is the Integrated Fisheries Management Plan (IFMP; DFO 2019), which integrates the expertise and activities of specialists from multiple DFO sectors, resource users and other stakeholders. The IFMP is both a process by which a fishery for a given species in a given region will be managed for a period of time, and a document which is an important reporting tool and information source about the fishery. Each IFMP provides a fisheries overview as well as a summary of scientific information, socio-economic overview, management objectives, management measures and criteria. Ecological information is provided for the most part by DFO Science in a well-established peer review process administered by the Canadian Science Advisory Secretariat (CSAS; DFO 2018a).

IFMPs were first introduced in the mid-1990s, and in 2011 a standardized approach to IFMP planning was developed, including an updated template and guidance document (DFO 2013). The update was made in light of emerging issues such as safety at sea, climate change, aquatic invasive species, species at risk and marine protected area networks, and included general guidance for the inclusion of traditional knowledge, economic, social and cultural considerations, access/allocation and shared stewardship considerations. The standardized approach to development of IFMPs includes, where possible, information regarding other social/cultural and economic uses within the IFMP boundaries, including other human activities that may impact or be impacted by the fishery so that cumulative impacts and potential conflicts between ocean users can be addressed. The inclusion of socio-economic information in the IFMP is led by the Policy and Economics Branch of DFO (DFO 2008).

IFMPs are written as "evergreen" documents, that are updated annually with the most recent information. Most of Canada's fisheries are now managed with an IFMP, with the expectation that all other, traditional fisheries management plans will be converted to IFMP once they expire. IFMPs are expected to be nested within the Integrated Oceans management (IOM) context, recognizing that fisheries are part of the broader coastal marine social-ecological system.

CFRN FRAMEWORK FOR COMPREHENSIVE EVALUATION OF FULL-SPECTRUM SUSTAINABILITY

The CFRN was a collaboration among academic researchers, the fishing industry, and DFO researchers and managers from across Canada (Thompson et al. 2019), which undertook research to enhance knowledge of aquatic ecosystems as they relate to management and

industry operations, reduce environmental impacts, inform decision-making, and evaluate the effectiveness of management strategies on sustainability. One of the twelve research projects initiated was to identify knowledge requirements of emerging EAM and integrated management that will place more emphasis on a broader view of sustainability, and prepare Canadian fisheries to be more sustainable and to participate effectively in EAM. To this end, an interdisciplinary team (including industry, government and academics with both social science and natural science expertise) developed a framework with a comprehensive set of candidate fishery objectives (Table 1) and potential performance indicators, which are linked to statements from Canadian policy and international agreements (Stephenson et al. 2019a). This CFRN Framework for comprehensive evaluation of full-spectrum sustainability (hereafter: the CFRN Framework), is based on four 'pillars' of sustainability; ecological, economic, social/cultural and institutional, and is considered to represent a comprehensive and practical expression of Canada's fisheries policy objectives and international agreements (Stephenson et al. 2018).

METHODS

Seventeen IFMPs in use in 2012 were examined in order to compare the breadth of information relating to ecological, social and economic aspects in Canadian fishery management plans with the CFRN Framework. The IFMPs represented both finfish (n=8) and invertebrate fisheries (n=9) from across Canada (Table 2). These fisheries varied in size and geographic range, and represented all six DFO regions.

Each IFMP was searched for key words related to the elements of sustainability and candidate objectives and potential performance indicators listed in the CFRN Framework (Table 1). The presence or absence of information was coded using one of three categories; no mention, listed as an aspiration, listed as an explicit objective. Results are expressed as the proportion of IFMPs within each of the categories for each CFRN Framework objective. As Institutional objectives, apart from obligations to Indigenous peoples, were not addressed explicitly in IFMP's those elements are included with social/cultural elements in this paper.

In order to gain a better understanding of the types and availability of data used in socio-economic analyses for the development of IFMPs, telephone discussions were held in 2013 with the head economists in each of DFO's six regions, during which they were asked to elaborate upon the socio-economic information currently being used in support of IFMP analyses, as well as where the data were housed and how they were utilized. The responses were organized into a table and presented to each of the economists for verification and revision.

RESULTS

A gradient in amount and specificity of objectives, information and analysis exists in the IFMPs across the sustainability elements, decreasing from the ecological through economic and social elements (Fig. 1). The ecological elements were considered in all IFMPs: These had explicit objectives, as well as supporting information and analyses for each of the expressed objectives. This was less the case for the economic elements. Information pertaining to the social elements contained the most limited amount of information, and the most general (or vague) aspirations. Overall, 77% of the candidate ecological objectives in the CFRN Framework were evident in the IFMPs (as either explicit objective or aspiration), compared to only 31% of the economic and 37% of the social objectives (Fig. 2). These findings must be considered with the caveat that the social element contains an objective relating to 'legal obligations to Indigenous Peoples', which is a policy-driven objective explicit in all of the IFMPs examined and strongly influences the amount of IFMP information shown for the social element (See below and Fig. 5).

The IFMPs contained ecological information, as either an explicit or aspirational objective, that satisfied each of the CFRN Framework ecological objectives. Most information was related to Physical Habitat (specified in 100% of plans), Secondary Productivity (94%) and Ecosystem Services (94%). On the other end of the spectrum, Primary Productivity was the CFRN Framework objective with the least amount of reference and information in the IFMPs (41%) (Fig. 3).

With respect to the economic pillar, the CFRN Framework objectives were present in the IFMPs, to varying degrees. The majority of economic information in the IFMPs related to the CFRN Framework objectives of Economically Prosperous (41%) and Economically Viable (65%) fisheries, and were stated explicitly as objectives. There was often reference to the objective of Economic Benefits to Community (59%), but it was primarily aspirational in nature. The IFMPs contained the least amount of information for the remaining CFRN Framework objectives; namely, Sustainable Wealth (6%), Employment (24%), Income (18%), and Equitable Trading Relationships (6%), and these were almost exclusively aspirational in nature (Fig. 4).

The gaps in IFMP information are most conspicuous for the Framework objectives relating to the social elements. Apart from the widespread objective reflecting Aboriginal Rights (100%), most of the IFMP information relating to this aspect is aspirational. The three most prevalent objectives are Environmental Health (65%), Occupational Health (59%) and Traditions/History (41%). There was no, or very little, IFMP information relating to Community Well-being (0%), Adaptive/Social Capacity (0%) and Human Health/Well-being (6%) (Fig. 5).

When the IFMPs were compared between Atlantic and Pacific coasts, differences in the amount of information were evident for some of the CFRN Framework objectives. The Atlantic IFMPs contained specific reference, and more information pertaining to ‘Optimizing Economic Benefits to Community’ and ‘Equity’, whereas the Pacific IFMPs incorporated more information relating to ‘Occupational Health’, ‘Environmental Health’, ‘Food Security’, and ‘Primary Productivity’.

Compilation of information from Regional Economists revealed a total of 27 different data types across all DFO regions that are available and utilized in social and economic analyses supporting IFMP development (Table 3). Of these, 13 data types are consistently used by all regions (noted on Table 3). The data are primarily housed within DFO, and to a lesser degree, the provinces and Statistics Canada. The data are mainly used to support economic analyses; including fisheries profiles, fleet cost and earning profiles, impact analyses and fleet diversification and market analyses. Cost and earning surveys have been conducted in the recent past, but have been discontinued and are now considered outdated.

DISCUSSION

Fisheries management is expected to evolve towards more holistic ‘ecosystem-based’ and ‘integrated’ approaches. While not yet fully articulated or operational, these approaches will inevitably include more diverse objectives with respect to sustainability, impacts of fishing on the ecosystem, as well as increased awareness of the impact of the ecosystem (including ecosystem change) on management as it strives to balance diverse societal objectives within ecological meaningful boundaries (see, for example definitions of Long et al. 2015, Garcia et al. 2014, Smith et al. 2017). Individual fishery plans (especially single-species plans) cannot in themselves equal an ecosystem approach, but as management is largely through single species plans it is important that individual IFMPs be consistent with EAM, and that the sum of plans (fisheries and plans for other activities in an area) form a comprehensive ecosystem-based management approach. This includes addition of ecological objectives to account for a more comprehensive view of interaction with the ecosystem, but it also requires consideration of

social, economic and institutional objectives that make up the other 'pillars' of sustainability. Fisheries management planning, therefore, requires the integration of diverse ecological, social economic and institutional aspects. This is explicit in Canada's Federal Sustainable Development Act (Canada 2008), is reflected in DFO's statements about Integrated Management (DFO 2002) and in the IFMP guidance document (DFO 2013), and was emphasized in the 2011 critique of current fisheries management by the Commissioner for Sustainable Development (Office of the Auditor General, 2011). Previously, there has been no agreed approach for what aspects should be included or how diverse aspects should be integrated in management plans. Canadian policy suggests the need for consideration of at least the spectrum outlined in Table 1 (Stephenson et al. 2019a). This represents a profound change in evaluation and management which, until quite recently, was dominated by conservation considerations of the target resource.

The CFRN Framework is one of only a few created in recent years with the intention of expanding planning objectives and aiding the implementation of EAM principles (Stephenson et al. 2018). The broad candidate objectives in the CFRN Framework reflect the comprehensive spectrum of objectives for sustainability of Canadian fisheries. Because it is rooted in Canadian policy and has been compared with international agreements, it may be considered the foremost framework for the consideration and implementation of EAM principles and full-spectrum sustainability in Canada to date (see Foley et al. 2019).

The integration of ecological, social, economic and institutional aspects in fisheries plans poses three major challenges: a) The expanded set of objectives necessitates new and different information, b) The integration of ecological, economic, social and institutional considerations requires additional capacity for analysis, review and evaluation and c) ecosystem-based management will require revised advisory and governance processes that will enable integration of an expanded set of objectives.

A) DATA SOURCES AND AVAILABILITY

Predictably, our scan of IFMPs across Canada shows that there is presently a shortfall of specific objectives and information most notably in the social and economic elements. To date the focus of socio-economic analyses to support IFMP development has been related to the policy priorities that support an economically viable/profitable fishery, and as a result the prominent information gaps are evident in other areas, especially relating to sustainable wealth, employment and income, as well as economic trading relationships. With respect to the social element, the CFRN Framework candidate objectives relating to Aboriginal rights, occupational and environmental health, as well as consideration of traditions and history were relatively well represented in the IFMPs. However, the IFMP information relating to the remaining social objectives (human health, human and community well-being and adaptive/social capacity) were negligible.

A serious challenge to the implementation of EAM in fisheries science and management is acquiring the information to support the broader objectives. New and different kinds of data are required; however, the capacity to provide the information has to be established. Fish harvesters increasingly recognize the need for enhanced information to fill critical knowledge gaps in stock assessment and management of important commercial fisheries. It is widely accepted that there is a wealth of information and knowledge within the fishing industry that is underutilized and/or poorly integrated into current fisheries science and management (Berkes 2008; Ommer et al. 2007; Haggan et al. 2007; Stephenson et al. 2016). It seems not only logical, but imperative, to support fish harvesters and the fishing industry generally in developing the capacity to contribute effectively to active sampling and the documentation of other aspects

of the fishery (Levin et al. 2018). There is enormous potential for improvement to the acquisition and use of industry information in most fisheries. The use of industry information not only will improve the data/information but also contribute to participatory management regimes (Stephenson et al. 2016). The literature on cooperative research and on co-management overwhelmingly points to the benefits of a collaborative approach. An industry that provides information is part of that information and more accepting of results. Participation in sampling usually leads to an increase in understanding of the use of the information and an increased awareness of the assessment and management processes, and forms a basis for development of increasingly participatory management regimes. Participation of key stakeholders such as resource users enhances the legitimacy of the regulatory regime, builds community, reduces conflict and improves compliance (Jentoft et al. 2010). Participatory or co-management regimes are seen as the only feasible form of management where governments lack resources for sampling and management (Jentoft et al. 2010).

In some fisheries, community group volunteers contribute to fisheries monitoring and management by enhancing observations of the resource. Around the world and for a breadth of topics, citizen science is advancing as an approach to overcoming insufficient data collection and monitoring due to restricted funding, and enhancing adaptive management, by enlisting members of the general public. The approach is evolving with advancing technologies and more formalized methods. Criticisms regarding data quality are decreasing with the advent of appropriate protocols and training. Citizen science has provided opportunities for people to address community-driven social and scientific questions and could help leverage traditional knowledge (TK) and traditional ecological knowledge (TEK). The inclusion of community in tending to the resource fosters a sense of responsibility for the resource and opportunities to strengthen the science-society relationship (Bonney et al. 2014; Papenfuss et al. 2015; Aceves-Bueno et al. 2015; Newman et al. 2012).

Within Canadian fisheries a gradient of industry participation and collaboration can be found (DFO 2004), ranging from consultation through to co-management (Stephenson 2016). Collaborative management has been a focus of fisheries management at DFO, however, there have been criticisms for missing important resource information due to a perceived refusal to integrate traditional fishers knowledge, or not using the information gained during consultation with the fishing industry. An adaptive and participatory model is required so that the use of stakeholder information can result in scientific products; one that addresses critical gaps in the steps required moving forward.

B) CAPACITY FOR REVIEW AND EVALUATION

The analysis of social and economic aspects of fisheries requires people with expertise (backgrounds and tools) not currently present in assessment and management planning (Benson and Stephenson 2017). The social science and economic expertise in Canada is largely in universities. This capacity will, in the short term at least, need to be brought to IFMP planning through interdisciplinary collaboration. The Canadian Fisheries Research Network was successful in fostering a strong interdisciplinary collaboration of the fishing industry and government with academic researchers, and demonstrated an increase in research capacity through its collaborative efforts (Thompson and Stephenson 2016).

In recent decades there has been close collaboration between DFO and the fishing industry; however, the link between academia and the fishing industry and academic involvement in applied Science has been relatively minor. Academics offer knowledge and expertise in disciplines such as sociology and anthropology that are not currently prevalent at DFO. The academic community has access to unique funding streams and they mentor students who can

undertake specific short-term research projects, and the benefits of collaboration are mutual when university students work on a specific problem alongside members of the fishing industry. Enhanced collaboration among academics, industry and government in applied fisheries research offers the great benefits to all participants (e.g. Thompson et al. 2019).

C) PROCESS

The legal framework for the integration of ecological, social, economic and institutional objectives in IFMPs exists in Canada; however, there is a general lack of process for routine integration of information related to full-spectrum objectives. The current governance system considers a subset of the social and economic objectives required by EAM and there is no institutional framework robust enough for consideration of the full spectrum of required information. The Canadian Science Advisory Secretariat (CSAS) which coordinates the production of peer-reviewed science advice through Regional or National Advisory Processes, focuses exclusively on ecological aspects of fisheries. There is no similar process for producing peer-reviewed social and economic advice, and no social science capacity within DFO to provide expertise on social aspects (Curran et al. 2012). As a result, while there are agreed methods, and even processes for evaluation, peer review and consensus advice of ecological aspects (e.g. Gavaris 2009; DFO 2017) there is no such strategy or framework in place for the consideration of objectives relating to the social, economic and institutional aspects of a fishery. Several methods have been put forward as being capable of integrating social, economic and institutional aspects (see review by Benson and Stephenson 2017), but there is no process in Canada in which to do this. This emphasis on (or bias towards) ecological aspects is a feature internationally and has been stated as one of the major impediments to integration of the four 'pillars' of sustainability (Stephenson et al. 2017).

At the time of this study, there were three other DFO marine resource management initiatives in Canada (apart from IFMP planning) in which social and economic objectives were being considered. These included integrated management planning in five Large Ocean Management Areas (LOMAs: e.g. Curran et al. 2012; McQuaig and Herbert 2013), development of a Network of Marine Protected Areas (MPAs; DFO 2018b) and the Recovery Potential Assessments (RPAs) that are required to inform the decision on listing wildlife species under the Species At Risk Act (SARA). DFO's Strategic Policy Sector has developed draft frameworks for socio-economic analysis, and for considering social and economic factors in these processes. Reports (in draft form) include: Guidance on cost-benefit analysis (DFO Strategic Policy Sector April 2016 (unpublished)); an Interim framework for integrating socio-economic analysis in the recovery cycle (Critical habitat orders and action plans) of the species at risk process (DFO Strategic policy sector July 2017 (unpublished)): and Guidance on incorporating economic use information into Marine Protected Area design (DFO Strategic Policy Sector July 2017 (unpublished)). While the application to date has been limited to case studies or pilots, they demonstrate an increasingly widespread need for a comprehensive ecosystem approach that is able to integrate ecological, economic, social (including cultural) and institutional considerations in integrated oceans management (IOM). There is need for a coordinated (whole of government) approach to ecosystem-based management of multiple activities (e.g. Stephenson et al. 2019b). The CFRN framework offers a basis for development of a consistent set of processes in which to discuss a broader set of objectives, and to compare alternate scenarios in relation to the trade-offs that are implied by multiple uses and by diverse, conflicting objectives (see Figure 2 of Stephenson et al. 2018). The effective use of such a framework for comprehensive evaluation requires a change in advisory process (to include processes and expertise to evaluate ecological, economic, social and institutional aspects) and development of a more participatory governance structure that is empowered to consider full-spectrum sustainability.

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TABLES

Table 1. Sustainability elements and candidate objectives used in this study, and as they eventually appeared in the published CFRN Framework (from Stephenson et al. 2019a).

Sustainability Element (this paper) **Candidate objectives**	**Sustainability Element** (Stephenson et al. 2019a) **Candidate Objectives**
Ecological Productivity Biodiversity Habitat	Ecological Productivity and Trophic Structure Biodiversity Habitat and Ecosystem Integrity
Social and Economic Economic/financial viability Distribution of Access and Benefits Regional economic benefits to community Sustainable communities Health and wellbeing Ethical fisheries	Economic Economic/financial value and viability Distribution of access and benefits Regional Economic Benefits to Community Sustainable Livelihoods Social Sustainable Communities Health and Well-being Ethical Fisheries
Institutional Institutional arrangements Good governance Decision-making	Institutional Obligations to law and Indigenous Peoples Good Governance Structure Effective Decision-making Processes

Table 2. Integrated Fisheries Management Plans considered in this study.

IFMP	DFO Region
Northern BC salmon	Pacific
Southern BC salmon	Pacific
Geoduck & Horseclam	Pacific
Shrimp Trawl	Pacific
Herring	Pacific
Dungeness crab	Pacific
Green sea urchin	Pacific
Dolly Varden	Central & Arctic
Inshore lobster	Maritimes
Herring	Maritimes
American oyster	Gulf
Gaspereau	Gulf
Area 19 Snowcrab	Gulf
3Ps cod	Newfoundland & Labrador
Snowcrab	Newfoundland & Labrador
Northern shrimp	Atlantic-wide
Atlantic mackerel	Atlantic-wide

Table 3. Socio-economic information considered by DFO in support of the Integrated Fisheries Management Plan analyses. Shaded cells indicate data used in all DFO regions.

Socio-Economic Data	Source of Information	Current Use of Information
Landings (weight)	DFO	understand dynamics, cost & earnings profiles, fishery profiles
Landed Value ($)	DFO	cost & earning profiles, fleet profiles, fishery reporting
Location of Landing	DFO	link harvest area to processing area
Effort	DFO	behaviour profiles in impact analysis, to determine active vs inactive licences
Species Directed	DFO	fisheries profiles
Species Caught	DFO	fisheries profiles
Form of Product	DFO	price comparison, plant production analyses
Quota	DFO	tracking fishery status
License Information	DFO	Fleet cost and earning profiles, impact analysis, fleet diversification
Vessel Used	DFO	Fleet cost and earning profiles, impact analysis, fleet diversification
Vessel Length	DFO	Fleet cost and earning profiles, impact analysis, fleet diversification
Gear	DFO	Fleet cost and earning profiles, to distinguish fleet for some fisheries
Age of Fisher	DFO	Fisheries profile and economic analyses
Buyer	DFO, Province	Fisheries profile, to determine volume of purchases
Processor	DFO, Province	impact analsysis, fishery profile
Fish Processed (weight)	DFO, Province, plant	impact analysis
Employment per Plant	DFO, Policy & Econ survey (2008)	jobs by region for regional impact analysis
Processing Value ($)	DFO, Province, plant	impact analysis, value by region
Processing Location	DFO, Province	economic impact analysis
Place of Export	DFO, Stats Can	for IFMP fisheries profile, importance of export market
Value of Export ($)	DFO, Stats Can	for IFMP fisheries profile, value of export market
Value of Import ($)	DFO, Stats Can	for IFMP fisheries profile, value of import market
Cost of Fuel ($)	Cost & Earnings survey (dated)	for IFMP fisheries profile
Cost of Labour ($)	Cost & Earnings survey (dated), CRA	some economic analyses
Exchange Rate	Bank of Canada	financial profiles
Market Price	Internet	financial profiles
Employment Data	Stats Can, Prov.	fisheries profiles

FIGURES

Sustainability Element	Objectives	Information	Analysis	Used in decision-making?
Ecological	Detailed	Detailed	Present	Yes
Economic	Present	Present	Limited	Yes
Social	General	Limited	Absent	Yes

Figure 1. The information gradient apparent in the scanned Integrated Fisheries Management Plans.

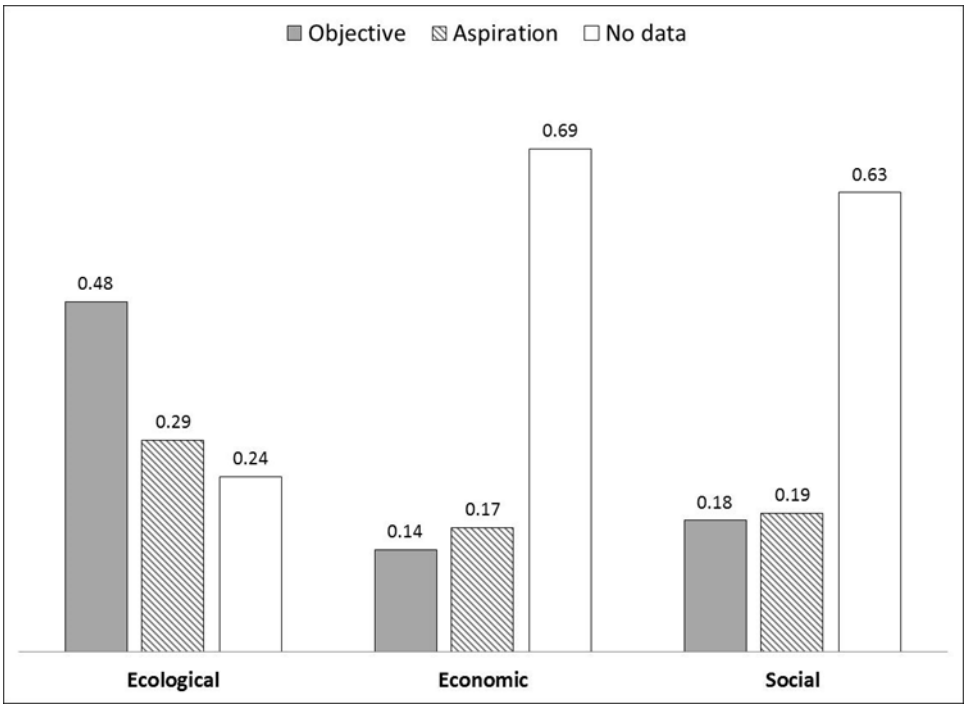

Figure 2. The proportion of CFRN Evaluation Framework objectives expressed as an objective, an aspiration or missing (no mention) by sustainability element in the scanned Integrated Fisheries Management Plans.

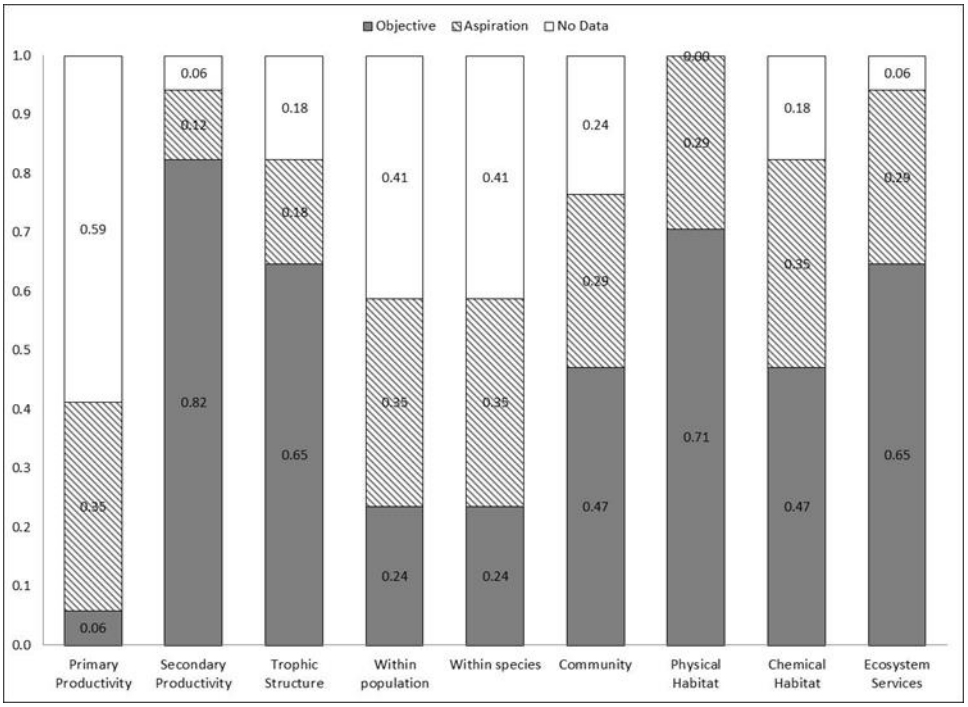

Figure 3. For the Ecological sustainability element: the proportion of CFRN Evaluation Framework objectives expressed in the Integrated Fisheries Management Plans as an objective, aspiration or no mention.

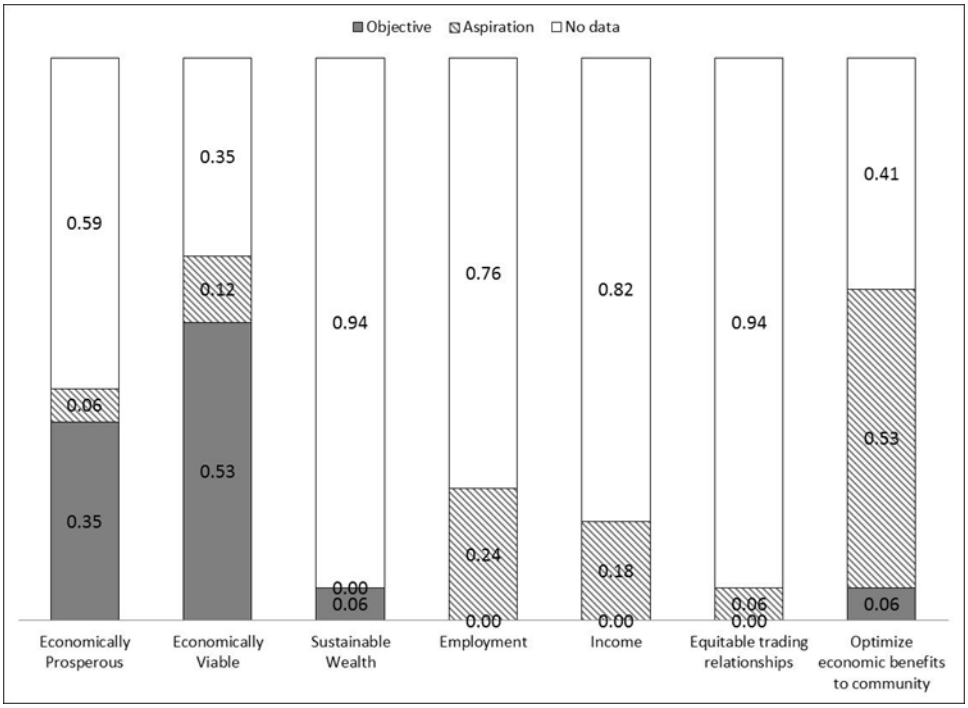

Figure 4. For the Economic sustainability element: the proportion of CFRN Evaluation Framework objectives expressed in the Integrated Fisheries Management Plans as an objective, aspiration or no mention.

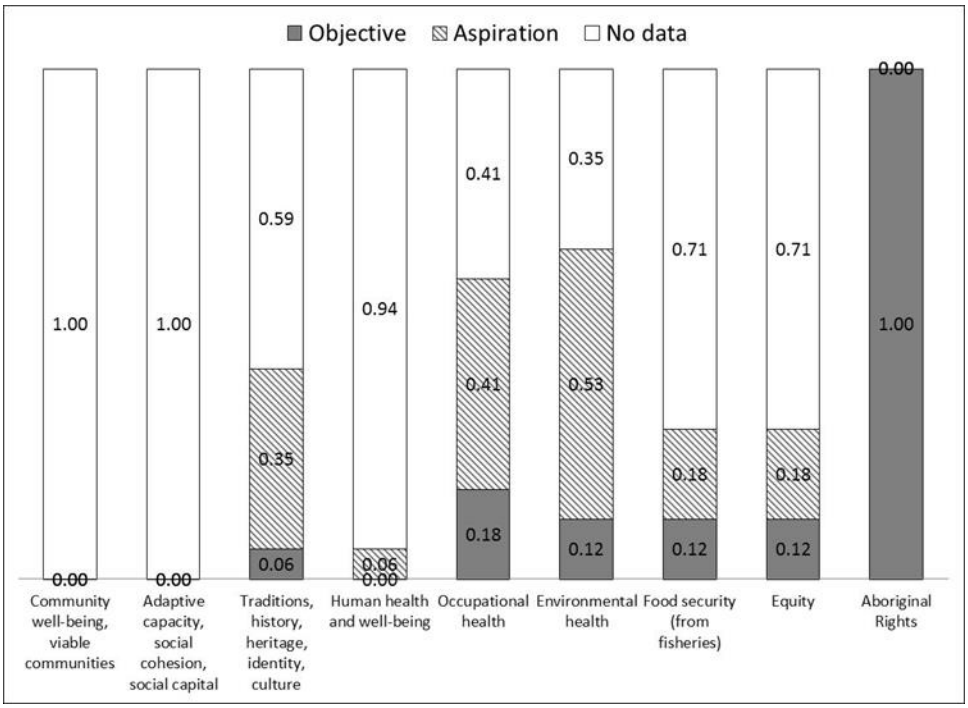

Figure 5. For the Social sustainability element: the proportion of CFRN Evaluation Framework objectives expressed in the Integrated Fisheries Management Plans as an objective, aspiration or no mention.