A Science-industry study of the Distribution of Fishing Benefits to the Community of Grand Manan, Bay of Fundy.

By

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A Thesis Submitted to
Saint Mary's University, Halifax, Nova Scotia
In Partial Fulfilment of the Requirements for
The Degree of Master of Science in Applied Science

March 28, 2019, Halifax, Nova Scotia

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Date: March 28th, 2019

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Abstract

To assess the state of Canadian fisheries, it is important to measure how benefits are distributed within, and across fishing communities and how this changes over time. I collaborated with government and industry members to identify and examine a suitable set of social and economic indicators that can satisfy this objective. Examining Grand Manan, New Brunswick, and communities in the Maritimes Region of Atlantic Canada, I tested the indicators using quantitative and qualitative methods. The quantitative methods included proportional trend, Lorenz Curve, Gini Coefficient, and spatial analyses. I collected qualitative data from participants who were knowledgeable of Grand Manan fisheries. I analyzed three case fisheries (lobster, herring purse seine, and mobile groundfish) for comparison based on: reports of changing distribution of community benefits, data availability, and the ability to interview knowledgeable participants. The results revealed that there was increasing unevenness in the distribution of benefits among and across communities, over time. Survey data documented a series of factors (e.g. resource scarcity, financial unviability, asset transferability, and a short-sighted management regime) which are driving the widening unevenness and reinforcing negative community effects. This research has the potential to guide future efforts which aim to understand distribution of benefits in fisheries, which is critical to policy and sustainable communities. March 28th, 2019

Acknowledgments

This research was sponsored by a National Science and Engineering Research Council (NSERC) grant, managed by the Canadian Fisheries Research Network (CFRN). Research facilities were provided by Saint Mary's University in Halifax, Canada. I sincerely thank my co-supervisors, Tony Charles and Rob Stephenson, for their patience and steadfast support throughout my academic journey. The knowledge I have learned from these gentlemen, and the connections I have made through the CFRN and their other academic networks are priceless -for that, I will forever be grateful.

I thank my committee members Ratana Chuenpagdee and Danika van Proosdij, as well as my external examiner Daniel Lane for their helpful insight and comments throughout their review. I extend my deepest gratitude to my close academic colleagues and collaborators from industry and DFO: Marc Allain, Melanie Sonnenberg, Bonnie Morse, Joe Walcott, Jazmine Hayden, Colin O'Neil, Andrea Haas, Danielle Edwards, Courtenay Parlee, Eric Angel, Mike Hawkshaw, Sarah Hawkshaw, Aaron Greenberg, Barbara Paterson, John Paterson, Rachel Wang, and Greg Baker.

Lastly, but certainly not least, to family, and friends – I could not have done this without your loving support. I feel like I have already won – pass or fail does not matter in my life now.

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Glossary

AHMC – Atlantic Herring Management Committee

AHFMC – Atlantic Herring Fishermen's Marketing Co-operative

Benefits – Provide advantages – stable or net positive gains – to the communities and sectors examined (Schuhbauer, Sumaila, & Chuenpagdee, 2015).

CFRN – Canadian Fisheries Research Network

CL – Carapace Length

Fishing Community – Is bounded by: the human population within a community spatial scale, the geographic area fished by community members, the institutions which govern the fishing activities of these people, and their unique social and economic characteristics (Boyd & Charles, 2006).

Distribution – The extent to which different "components" of society have (access to or ownership of) different "units" (Coulter, 1989).

DFO – Fisheries and Oceans Canada

EEZ – Exclusive Economic Zone

EAF – Ecosystem Approach to Fisheries

Equity – A normative set standard in which the level of inequality is determined to be fair (Coulter, 1989).

Fleet Separation Provision – Precludes the corporate ownership of 'new' licenses for <65ft vessels (DFO, 2003).

GMFA – Grand Manan Fishermen's Association

ICNAF – International Commission for the Northwest Atlantic Fisheries

Inequality – The variation (i.e. unevenness) across the distribution examined and that "variation is the changing form, condition, or substance from a former or usual state or from an assumed standard" (Coulter, 1989).

ITQ – Individual Transferable Quota

IQ – Individual Quota

LFA – Lobster Fishing Area

NAFO – Northwest Atlantic Fisheries Organization

Owner-Operator Provision – Requires license owners to fish the license personally (DFO, 2003).

PIIFCAF – Preservation of the Independence of the Inshore Fleet in Canada's Atlantic Fisheries

SES – Social-Ecological System

TAC – Total Allowable Catch

Trust Agreement – The beneficial interest of a license is held in 'trust' between a financing entity and a license holder (DFO, 2003).

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Chapter 1: Introduction

Research motivation and objective

Fisheries systems are inherently complex social-ecological systems (SESs) where human systems of society, economics, and governance are coupled within ecological systems. Fisheries stock collapses have contributed to negative effects throughout the societies and economies that rely on these fisheries resources. Although the reports cite over-exploitation as the principal driver of resource scarcity, the literature also criticizes conventional regimes for their assessment and management of these resources, which have contributed to social-ecological change in fisheries systems (Stephenson, et al., 2018; Berkes et al., 2014; Barnett, 2014; Garcia, Rice, & Charles, 2014; Paterson & Kainge, 2014; Charles, 2013; FAO; 2009; Ostrom, 2009; Lui et al., 2007; Wilson, 2006; Hughes et al. 2005; Berkes, Folke & Colding, 1998).

The conventional fisheries management paradigm has been based on a single-species productivity model, which only incorporates a narrow suite of scientific data on catches and populations. Within the last few decades, the Food and Agriculture Organization of the United Nations (FAO) and others have challenged the conventional paradigm for its "poor performance" and have repeatedly called for a holistic ecosystem approach to fisheries (EAF). Proponents argue that an EAF offers a new management paradigm which considers all aspects of multi-species fisheries SESs, which includes topics of social and

economic analysis, including equity and fairness (the manner in which coastal communities are impacted by the distribution of net benefits). EAF proponents point out that social and economic, and, in particular, equity and fairness aspects have been ignored in conventional fisheries management. They emphasize that to move towards an EAF will require an integration of scientific, local, and traditional knowledge, using quantitative and qualitative analyses, with broad stakeholder participation. To accomplish this, an EAF will require a rigorous monitoring system of indicators which are (in part) contextualized based on policy objective outcomes (Stephenson, et al., 2018; Angel, et al., 2014; Barnett, 2014; Charles, 2014; Garcia, Rice, & Charles, 2014; de Young, Charles , & Hjort, 2008; Paterson & Kainge, 2014; Charles, 2013; Berkes & Ross, 2012; Long, 2012; FAO; 2009; Boyd & Charles, 2006).

I aim to contribute to the understanding of fisheries SESs through the lens of social and economic dynamics and aspects of EAF management objectives of equity and fairness, which are often overlooked. Coulter (1989) wrote that equity is a standard level of distributional unevenness which is determined to be fair. However, Haas (2014) explained that there is no standard measure of equity within the current Canadian fisheries management paradigm. Consequently, I explore the dynamics concerning the distribution of net fishing benefits and the extent of unevenness within coastal communities, which would be assumed to be important to policy objectives and management under an EAF. Furthermore, I analyze three case fisheries in the community of Grand Manan, NB in response to reports from the independent harvesting

sector regarding changing distribution of benefits. According to this industry group, Grand Manan fishery trends mirror those reported internationally – as an implication of declining resources and failed ecological policy objectives, the community experienced a net loss of benefits, over time, which has reinforced other negative community effects.

A longitudinal study by Marshall (2009) used a primarily qualitative approach to record the change to Grand Manan fisheries. At the onset of the study in 1995, she described the community as vibrant and diverse with traditional fishing industries that provided the foundation for the island's cultural identity and resilience. In later years, she documented that the community was negatively impacted by declining fisheries resources which created a downturn throughout the social economy. Her findings reaffirm global literature sources and she wrote that these dynamics triggered the erosion of the community's resilience. Furthermore, Marshall argued that cumulative constraints 'contributed to fissures within the community', which resulted in growing income disparity and increased barriers to fisheries access for new entrants (Marshall, 2009).

Research objective, scope and organization

I examine the changing distribution of net fishing benefits to the community of Grand Manan as an assessment of EAF policy objectives of equity and fairness. Based on the reports of changing distribution, I evaluate the community's lobster, herring purse seine, and mobile groundfish fisheries. To accomplish this objective, I first explore the

literature and policy context regarding the need for this assessment, in chapter 2. I review literature on distribution to form the basis of my analysis. I use accepted approaches for indicator development to analyze existing global frameworks to develop a suite of indicators, which are relevant to this research. The process includes collaborating with academic, industry, and government partners to help conceptualize the research objectives, scope, and knowledge (local and scientific) availability.

In chapter 3, I test the utility of a suite of indicators on the Grand Manan case fisheries. I examine the distribution of community benefits with mixed quantitative and qualitative approaches. I compare the indicator results of several methodologies and analyze the efficacy of each to measure local-scale distribution of benefits. Recognizing that fisheries function across multiple geographic scales, I incorporate an assessment which explores these cross-scale connections regionally. Moreover, I use a foundation of indicator development, and collaborative research approaches to examine the broader implications of changing distribution of community benefits.

The goal of my research is to answer a series of questions. Firstly, what is the extent of changing distribution of benefits within the Grand Manan case fisheries? Using the suite of indicators I compare the past distribution to that of the recent distribution of benefits. It is also important to know what knowledge sources are available. Furthermore, is collaboration with members of the fishery a useful tool in examining distribution of benefit? Lastly, what insights can be gleaned which may help future policy

and research efforts? In chapter 4, I summarize key insights from chapters 2, and 3, in context of these thesis questions. I contrast the questions I answered against the questions that remain. I conclude with future research and policy implications.

Chapter 2: Selecting Indicators to Measure Distribution of Fishing Benefits to the Community of Grand Manan, Bay of Fundy.

Introduction

Policy Context

Beginning in the 1990s, the Canadian federal government made incremental changes towards an Ecosystem Approach to Fisheries (EAF). The EAF efforts included participation in various international agreements (under the auspices of the FAO) by the Canadian government and its Fisheries and Oceans (DFO) agency, as well as implementing integrated fisheries management plans (IFMPs). The aim of IFMPs was to provide a framework for evaluating fisheries social-ecologic systems (SESs). However, DFO has criticized its own implementation of the EAF, stating that many fisheries have outdated IFMPs, or none at all (DFO, 2013a). In 2011, the Auditor General's Report (Report of the Commissioner of the Environment and Sustainable Development – A Study of Managing Fisheries for Sustainability) also criticized Canadian governments (specifically, federally and provincially) and their management agencies for not considering all fisheries systems dynamics, especially social and economic components. The report stressed the importance of community scale and distributional equity.

In 2010, the Canadian Fisheries Research Network was established by a national group from academia, industry, and government to enhance collaborative research on several topics including the EAF. Particularly, one project linked an interdisciplinary group of

academics, industry stakeholders, and government officials to define a Comprehensive Fisheries Sustainability Framework (hereafter referred to as the CFRN Framework - Table 1; Appendix A). Within the framework's social and economic domain and equity and fairness dimension, the collaborators also emphasize the importance of evaluating community level impacts and the distribution of benefits (Stephenson, et al., 2018; Angel, et. al., 2014). These elements are derived from the following Canadian and international EAF equity and fairness policy objectives:

- "Access to the fishery is allocated equitably and predictably among the interested parties" (Auditor General of Canada, 2011).
- "Intergenerational equity (i.e. ensuring fairness in allocation and use of resources between generations) and intragenerational equity (i.e. ensuring fairness in allocation and use of resources within the current generation) are central to the concept of sustainable fisheries management and should thus be key principles guiding efforts to move toward more responsible approaches to fisheries management through EAF" (FAO, 2009).
- "Ensure that the benefits of fishing licenses flow to the fish harvester and the coastal community" (DFO, 2010).

These three EAF policy objectives are examined under the equity and fairness dimension of the CFRN framework, which are defined by the following elements:

Box 1. Equity and fairness elements derived from the CFRN framework (Angel, et al., 2014).

Allocation: Fairness in the allocation of resource benefits
Stability: Stability of access to resource benefits
Costs & Benefits: Equitable distribution of benefits and costs
Risks & Rewards: Equitable distribution of risks and rewards
Livelihoods: Sustainability of livelihoods

In the context of analyzing the distribution of fisheries benefits to Grand Manan, I examine the distribution of resource quantities (i.e. allocations), access, and other benefits among harvester groups and communities, and whether this remains stable or becomes more or less equal over time. Examining and developing such measures based on these contexts provides information on the functionality of the fisheries systems examined, and the driving factors of distributional change. Barnett (2018) and others highlight that the full assessment and consideration of distribution of benefits to fishing communities is often disregarded; thus, making it difficult to monitor distributional effects with insufficient data sets (Barnett, 2018; Copes & Charles, 2004; McCay, 1996). Accordingly, this research was motivated by these key deficiencies in fisheries sustainability monitoring – where the goal is to inform future research and policy.

Indicator Selection Approaches

The reviewed literature provides guidance on the process of fishery indicator development. This guidance explains the necessary steps to develop indicators which reflect the objectives being evaluated (termed the evaluand) (Edwards, 2008). Although the literature varies on the number of steps required in the process to develop project-specific indicators, the content of the guidance is similar. Initially, the indicator development process must (1) define the subjects and boundaries of the system to be assessed, (2) develop the evaluand to reflect the agreed-upon policy objectives being used and meet the needs of relevant users (i.e. industry stakeholders, academics, or government members). Edwards (2008) states that the evaluand should be developed collaboratively with an identified group of relevant users who wish to participate in the indicator selection process. Collaborative processes often empower all contributors by enhancing participant communication, trust, confidence, and beneficial social networks (i.e. social capital), along with strengthening the scientific robustness of the project's design (Yochum, Starr, & Wendt, 2011; Wiber, Charles, Kearney, & Berkes, 2009).

Boyd and Charles (2006) recommend compiling a comprehensive set of candidate indicators. Since it is not practical to report on all candidate indicators, the set should be reduced using screening criteria (Rice & Rochet, 2005). Also, since there is no universal number of indicators or criteria to define their selection, I itemize a generic overview of indicator selection criteria used in previous studies. Moreover, Edwards (2008) ensured the selected indicators were reflective of the evaluand and policy objectives. As it relates

to this thesis, selected indicators must adhere to the subject definitions of distribution, benefits, and community. Boyd and Charles (2006) define a fishing community as one that is bounded by: the human population within a community spatial scale, the geographic area fished by community members, the institutions which govern the fishing activities of these people, and their unique social and economic characteristics.

Additionally, Edwards (2008) screened indicators based on data availability – they examined the underlying attributes or metric options which provide the analytical basis for each indicator. She argued that indicator data must be: appropriate in temporal scale, scientifically valid, accurate and precise, adequately documented, current, directly measurable, acceptable in spatial scale and consistent in scope, quality, currency, scale and sampling methods. Furthermore, indicator data shall be practical and screened accordingly. Practicality is based on the feasibility (in time, space, and financial resources) for investigators to properly monitor, analyze and report on the indicators. Indicators are highly practical and pass this level of scrutiny if data are readily available and easily interpreted at the scale of the fishing community (Edwards, 2008).

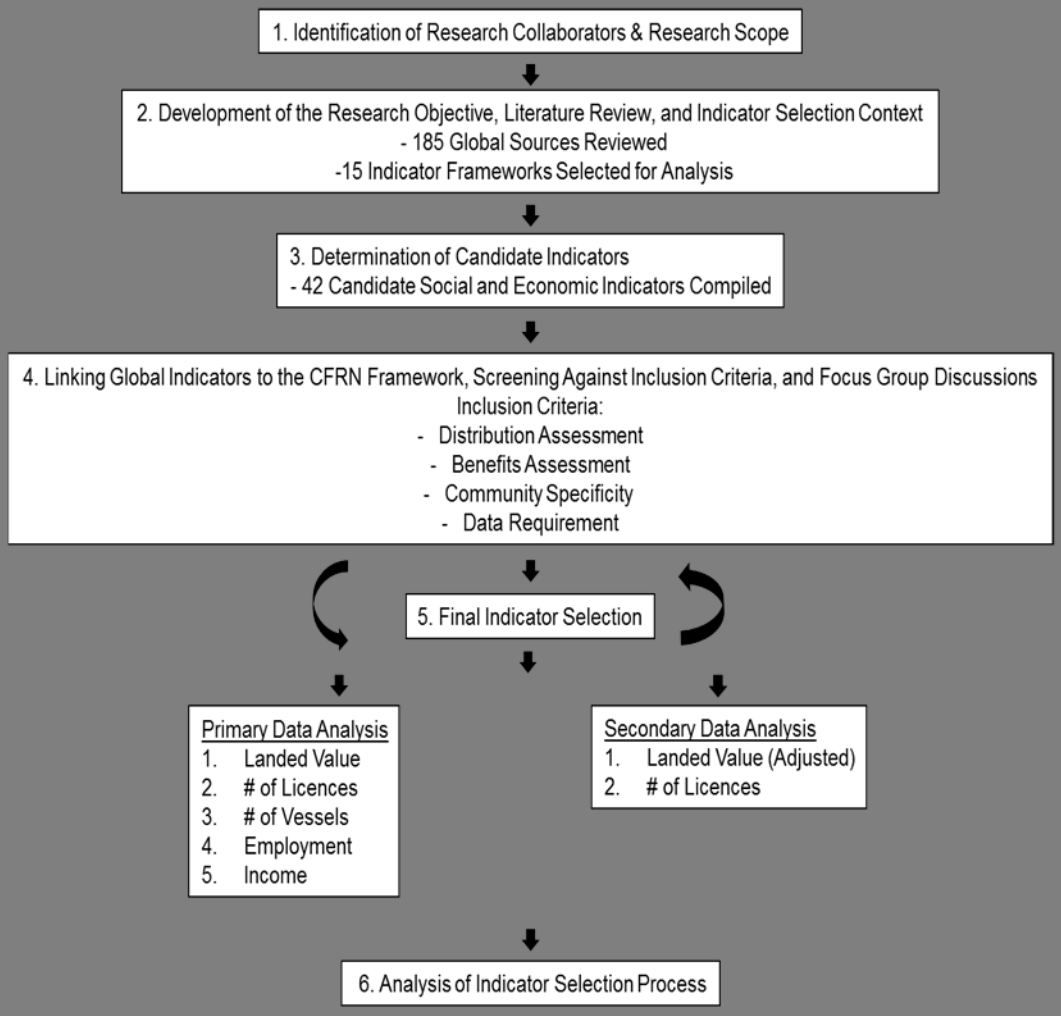
Lastly, the indicator selection process should be iterative and continually evolving based on new information and research demands from the literature, industry experts, research collaborators, and governing institutions. The final stage involves reporting on the subset of indicators which satisfied all screening criteria. The report provides a

retrospective analysis of the indicator selection process and offers insights for future research (Edwards, 2008; Boyd & Charles, 2006; Rice & Rochet, 2005).

Methodology

I used an analytical and iterative 6-step process (Box 2), based on the contexts of approaches in the literature, to select indicators which can assess the changing distribution of fishing benefits to the community of Grand Manan. Consequently, the selected suite of indicators functions to assess the outcomes of the EAF equity and fairness policy objectives – by evaluating how fishing benefits are distributed across coastal communities, participants, and generations, over time. The following steps draw on the theoretical bases of social-ecological systems, distribution, indicator selection, and collaboration.

Box 2. Conceptual diagram of the 6-step indicator selection used in this research.



In step 1, a thesis co-construction committee consisted of myself, my supervisors, and a network facilitator, and functioned as a formal arrangement between SMU and the CFRN. In discussions with the thesis co-construction committee, I identified collaborative research partners from the Grand Manan Fishermen's Association (GMFA; representing the community's fishing industry) and DFO on the basis that they possessed in-depth

knowledge of Grand Manan fisheries. This knowledge informed the research scope – the collaborators alleged that the three case fisheries display increasing disparity, the cases would enable cross-comparison, and data are available.

In step 2, I developed the thesis objective through a process of co-construction with my supervisors and a CFRN network facilitator. I reviewed fisheries policy, the literature, and derived the thesis objective to explore the subjects of distribution of community fishing benefits, which is ignored in current policy and identified as an industry research need. I searched the policies and literature using the following key words, and various key word combinations: socioeconomics, indicators, fisheries, distribution, benefits, equity, inequality, inequity, sociology, social impact assessment, fisheries management, sustainable fisheries, economics, ecosystem approach to fisheries, property rights, integrated fisheries management plans (for lobster, herring, and groundfish in Atlantic Canada), and DFO licensing policies. I subsequently researched the literature based on the thesis key words, which inevitably led me to research additional topics related to the distribution of community fishing benefits.

There is no consensus (in policy and the literature) regarding the number of indicators required to assess the distribution of fisheries benefits. Thus, I aggregated indicators at the higher domain level. Since distribution theory is rooted within the social and economic domain, I aggregated candidate indicators to consider all factors affecting fisheries performance within this domain.

In step 3, I derived the candidate indicators from global fisheries frameworks found within the literature. I selected the frameworks on the premise that they included indicators which analyze the social and economic domain. The aggregation reached a saturation point at 13 global indicator sources – where the global sources did not reveal any new information regarding social and economic indicators (Mason, 2010). I reference all indicators to their corresponding frameworks.

In step 4, I scanned the CFRN Framework, and its attributes list, to find the location of each candidate indicator. I then organized the candidate indicators by their relevant connection to the dimensions and elements of the CFRN framework (Tables 2-7). Although 9 indicators are missing from the CFRN framework, I related each to the dimensions and elements which fit best. For example, I linked employment per landed weight and employment per landed value (Charles, et al., 2002) to the equitable distribution of benefits and costs, the sustainability of livelihoods (elements), and the equity and fairness (dimension). The former two indicators relate to labour which falls under the latter elements and dimension.

I further screened the candidate indicators against the selection criteria (below). Edwards (2008) describes that indicators shall be selected based on criteria that pertain to the research objectives and requirements. Thus, I screen the indicators in terms of their usefulness to measure the distribution of fishing benefits to community with available data.

I excluded any indicator that did not explicitly meet the parameters of the criteria. For ease of analysis, I did not explore the development potential of indicators which did not meet these strict criteria. For inclusion into the final set, indicators (i.e. appropriate for testing) must explicitly measure and reflect the EAF equity and fairness objectives as they pertain to distribution (particularly change in disparity), assessment of benefits, community specificity, and data requirements.

Distribution theory examines the sharing of units between components within the human dimension (Coulter, 1989). Thus, I screened the candidate indicators and their metrics against their ability to evaluate distribution by Coulter's (1989) definition. Also, since one policy objective references measuring distribution across generations, indicator data must be able to assess distribution through time.

I also evaluated the capacity of the candidate indicators and fundamental data to measure the distribution of beneficial 'units' across the fishing community(ies) and sectors in the research scope. Fishing benefits must provide advantages – stable or net positive gains – to the communities and sectors examined (Schuhbauer, Sumaila, & Chuenpagdee, 2015).

The underlying metric data supporting the candidate indicators must also reflect the scale of the human community I examined - given the population, the geographic boundaries where the people live and where they fish, the governing institutions at this

scale, and social and economic structure (Boyd & Charles, 2006). Available institutional data bounds the municipality of Grand Manan as the main island and its comprised townships (excluding the extended archipelago; Figure 1). Local harvesters exploit species throughout the Maritimes Region [NAFO areas 4VWX5Y, and Lobster Fishing Areas (LFAs) 38 and 38B] and DFO manages fishing activities. Additionally, by recognizing geographic connectivity and the overlapping resource use by multiple communities, I considered the availability of community-specific indicator data for adjacent communities to explore cross-scale linkages with Grand Manan.

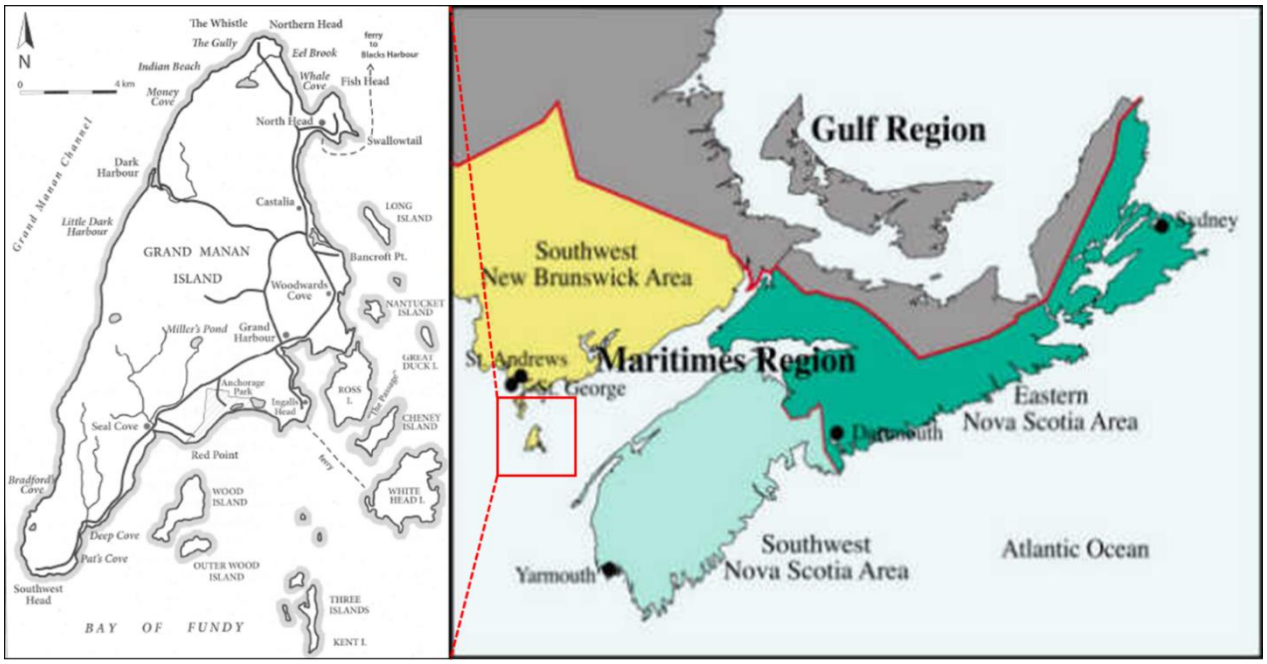


Figure 1. Maritimes regional map with inset Grand Manan map (DFO, 2014a; Marshall, 2009).

I assessed the candidate indicators against the knowledge sources available for the case fisheries in Grand Manan. The process included examining the potential to collect data using local knowledge (LK - via primary data collection) and archival (secondary) data

sources. The GMFA collaborators helped identify the capacity to collect primary LK data, through a series of iterative discussions.

Also, during this process, the research collaborators helped to assess whether the indicators are relevant to their needs as stakeholders and understandable to the local knowledge holders they represent.

Examining the existing secondary datasets, I consulted the institutional databases of DFO, Statistics Canada, Transport Canada, and the Municipality of Grand Manan. I also assessed the practicality to collected data by considering the constraints of the research scope.

In step 5, I separated the candidate indicators into 6 tables (below) by the following reoccurring social and economic themes (which frequented the discussions and readings):

- Fisheries access – indicators evaluating the types of physical capital required to access a fishery (i.e. licenses and/or quota)
- Capital inputs – indicators which evaluate fishing effort and input investments
- Labour – indicators relating to human capital inputs and characteristics
- Capital flows at the enterprise scale – indicators which assess the economic activity of businesses (i.e. monetary outputs and other transactions)
- Financial information – indicators which examine the monetary outputs and exchanges at the scale of individuals
- Others category - social and economic indicators which do not fall within the previous themes

Lastly in step 6, I report on the indicator selection process, discuss positive outcomes, and critique constraints. I offer insights regarding the process and explore the needs for future research and policy efforts.

Results

In step 3, the candidate aggregation revealed 42 social and economic indicators that exist within the 14 framework sources examined, with varying frequency. The 14 global sources of indicator literature revealed two indicators associated with fisheries access (Table 2). I selected the 'number of licenses' indicator as appropriate for testing as it met all screening criteria (as described in step 4 under methods above). Archival data are readily available for the community of Grand Manan and case fisheries. According to the GMFA collaborators, local knowledge holders have a deep understanding of fisheries licenses and their distribution patterns spanning decades. Licenses provide fisheries access, which yields benefits to society (in the form of revenue, livelihoods, etc.). Furthermore, distribution can either be expressed quantitatively (e.g. proportional trend, charts, maps, Lorenz Curves, etc.) or qualitatively such as by the perception of trends (e.g. relative changes to the number of licenses held within each Grand Manan fishery, over time). I rejected the quota indicator because I would not be able to assess quota distribution - since not all fisheries are managed that way.

Table 2. Fisheries access indicators.

Relevant Dimension	Relevant Element(s)	Indicators and Descriptions
Equity and Fairness	Fisheries access: Equitable distribution of benefits and costs Stability of access to resource benefits	Selected for Testing
		Number of licenses (Δ in access) [1,4, 5, 6, 12, 13] In limited entry fisheries, harvesters and firms require fishing licenses to gain access to the fisheries (e.g. commercial, recreational, or ceremonial) (DFO, 1996). Licenses enable individuals (license holders and/or employees), firms, and economies, at all scales to gain many benefits. Licenses afford license holders to gain revenue, income, they provide employment to employees, generate multipliers throughout the economy, and bolster cultural livelihoods. Therefore, licenses act as an overarching benefit to society (Gough, 2007; Edwards et al., 2006; Copes & Charles, 2004).
		Excluded from Testing
		Distribution of quota [1, 6, 7, 12] This indicator measures the unevenness that exists between allocations of catch shares to individuals (e.g. individual quota), groups (e.g. community quotas), or firms (e.g. enterprise allocations) (Angel et al., 2014; MRAG Americas, 2014; Copes & Charles, 2004).

Table 3 displays three indicators, which several authors categorized as capital inputs (MRAG Americas, 2014; Charles, 2005; Schirmer & Pickworth, 2005; Copes & Charles, 2004; Bonzon, 2000; FAO, 1999). The number of vessels indicator met all screening

[1]Angel et al., 2014
[2]Dayarathe & Sivakumaran, 1994
[3]GPCE, 2006
[4]Raymond, 1985
[5]Charles et al., 2002
[6]MRAG Americas, 2014
[7]FAO, 1999
[8]Boyd & Charles, 2006
[9]DFO, 2011a
[10]Pollnac et al., 2006
[11]Seung & Zhang, 2011
[12]Schirmer & Casey, 2005
[13]Schirmer & Pickworth, 2005
[14]Charles, 1989

criteria; thus, it is useable for further testing. The collaborators stated that potential interviewees could easily and accurately describe changing vessel numbers and distribution amongst the case fisheries in Grand Manan. Although Transport Canada has maintained a vessel registry for decades, the agency does not pair the data to the vessel's fishery, making it difficult to interpret. Consequently, I do not use the archival vessel data in chapter 3.

I examined vessels as a means for fishing communities to generate future benefits, up to a certain point. Beyond bio-economic equilibrium, the costs associated with maintaining an increasing number of vessels will yield net losses (Panayotou, 1982). Therefore, it is important to recognize when the number of vessels in the case fisheries are yielding net positive benefits, zero benefits, or net negative benefits (i.e. costs to the fishing community).

I rejected the capital investment and vessel capacity indicators since archival data collection is sporadic, and analysis would prove difficult. Also, the LK assessment revealed that it would be difficult for knowledge holders to describe investments and vessel capacity distribution as there is a wide degree of variation in these patterns.

Table 3. Fisheries input/effort indicators of physical capital.

Relevant Dimension	Relevant Element(s)	Indicators and Descriptions
Equity and Fairness	Capital inputs: Equitable distribution of benefits and costs Stability of access to resource benefits	Selected for Testing
		Number of vessels [1, 3, 4, 6, 7, 10, 11] Vessels are physical capital inputs and necessary for commercial fisheries production. Researchers can also use vessel metrics to indicate the level of fishing effort (MRAG Americas, 2014; FAO, 1999). Although vessels are initial capital costs, I treat them in a positive manner as they are investments spent to yield potential future benefits (e.g. profits, income, employment, etc.) (Charles, 2005).
		Excluded from Testing
		Capital investment [1, 2, 7, 10, 13] The literature defines capital investment as the measure of the total present value component (i.e. capital) of the production process, taking into consideration depreciation (Schirmer & Pickworth, 2005; Bonzon, 2000; FAO, 1999). This indicator typically refers to the money invested in vessels but can also refer to investment in processing facilities.
		Vessel capacity [4, 7, 8, 10] Vessel capacity is often a quantification of fish storage volume. Vessels with larger fish holds have greater capacity enabling the ability to catch larger quantities of fish (i.e. increased catching power) (Copes & Charles, 2004; FAO, 1999).

Table 4 displays 8 indicators pertaining to labour characteristics. These indicators examine the number of people employed in fisheries. Currently, Statistics Canada and DFO do not track labour in relation to fisheries, at the community scale. Fortunately, LK holders have a strong understanding of employment distribution within the case fisheries of Grand Manan, and how employment benefits this community. Thus, I selected employment for further analysis on these grounds. I rejected the other labour indicators since the collaborators consider these too complex for knowledge holders to accurately describe the distributions. These indicators require quantifications which the

knowledge holders and institutional databases are unable to provide at the local fisheries scale.

Table 4. Indicators which assess labour dynamics in fisheries.

Relevant Dimension	Relevant Element(s)	Indicators and Descriptions
Equity and Fairness	Labour: Equitable distribution of benefits and costs	Selected for Testing
		Employment [1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14] Many authors define employment as paid labour. With available data, the literature typically evaluates the indicator as the number of people employed in a social unit or as a rate (percentage of people employed in comparison to the total labour force) (Clay, Kitts, & Pinto da Silva, 2014; MRAG Americas, 2014; DFO, 2011a; Kitts, et al., 2011; Schirmer & Casey, 2005; Charles et al., 2002; Bonzon, 2000).
		Excluded from Testing
	Sustainability of livelihoods	*Employment diversity* [1, 2, 3, 4, 5, 6, 10, 12, 13, 14] The CFRN framework specifies that analysts can evaluate employment diversity, at various scales (including within communities), based on multiple attributes (e.g. gender, ethnicity, age, etc.) (Angel et al., 2014). The indicator assesses the variety of employment options available. Employment diversity is also socioeconomically beneficial, as diversity is a main component of resilience (Hansen et al., 2015; Berkes & Ross, 2012; Marshall & Marshall, 2007; Charles et al., 2002).
		Participation [1, 3, 4, 6, 7, 9, 10, 12, 13] In the fisheries context, participation is (typically) a quantification of people actively involved in the fishing industry. Many studies use employment and participation indicators interchangeably; however, participation may also monitor unpaid workers or volunteers (Schirmer & Casey, 2005).
		Unemployment [1, 3, 4, 7, 9, 12, 13, 14] The literature defines unemployment as the number of people (within the labour force) that are not working, and analysts typically measure it as a rate (percentage of unemployment in relation to the total labour force) (GPCE, 2006; FAO, 1999; Raymond, 1985).
		Dependency [1, 4, 10, 12] In the context of this research and the literature, dependency is the proportion of fisheries employment in relation to total employment (Angel et al., 2014; GPCE, 2006; Schirmer & Casey, 2005; Raymond, 1985). In 1985, Raymond, and colleagues, compared dependency ratios between communities.
		Number of EI claims [1, 4, 9] In the Canadian context, employment insurance (EI) is a government wage subsidy; it provides supplemental income, during periods of unemployment (DFO, 2011a; Gough, 2007). In 1985, Raymond, and colleagues, quantified the distribution of EI beneficiaries, by community. Analysts can also measure the number of EI claims as a proxy for unemployment.

		Employment per landed weight [5] This indicator assesses the number of people employed per unit of catch. In 2002, Charles and colleagues quantified this indicator by metric tonne, at the sub-national (provincial) scale, using a trend analysis over 10 years.
		Employment per landed value [5] This indicator assesses the number of people employed per unit of landed value. Charles (2002) and colleagues quantified this indicator per million dollars (CAD) generated by the Nova Scotian (provincial scale) fisheries, using a trend analysis over 10 years.

Authors regard 15 indicators (Table 5) as useful for examining enterprise capital flows. I determined that landed value was ideal for further testing since archival data and LK is readily available for the case fisheries in Grand Manan. Although other researchers may find catch and price useful to monitor, I categorized these indicators as redundant since landed value is a function of catch and price. I rejected all other enterprise capital indicators because they would require extensive costs and earnings surveying - which was beyond the feasibility of the research scope.

Table 5. Indicators which examine enterprise production and associated capital flows.

Relevant Dimension(s)	Relevant Element(s)	Indicators and Descriptions
Economic and Financial	Enterprise capital flows (revenue, costs, production, and contracts): Efficiency - Maximization of harvest value relative to waste Financial viability of fisheries enterprises Healthy and functioning of markets for	Selected for Testing
		Landed value (Turnover; T) [1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13] This indicator is also known as gross revenue or turnover (T) at the production level of the value chain; it is the product of a fishery's total landings (typically aggregated annually) and ex-vessel price. Landed value is an overarching benefit to society as employment income is derived from the revenue. Also, as the landed money is spent, it compounds throughout sectors of the local-national economies (known as the economic multiplier effect) (Edwards et al., 2006; Copes & Charles, 2004; Hughes, 2003; FAO, 1999; Seijo, Defeo, & Salas, 1998; Lawson, 1984).
		Excluded from Testing
		Catch [1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 14] Catch refers to the total quantity of fish harvested and also refers to as fishing mortality (F)(FAO, 1999; Seijo, Defeo, & Salas, 1998). The proportion of fish landed (i.e. landed weight), is an attribute of catch; thus, I categorized landed weight under the catch indicator.
		Total Costs (TC) [1, 2, 6, 7, 10, 11, 13, 14]

Equity and Fairness	goods, services and capital Sustainability of profits at all stages of the value chain Equitable distribution of benefits and costs	Total costs are the sum of variable [costs dependent of the fishing activity (e.g. fuel, food, wages, etc.)] and fixed [costs independent of fishing activity (e.g. capital investments in vessel, licenses, quota, etc.)] costs (Bonzon, 2000; FAO, 1999; Seijo, Defeo, & Salas, 1998; Lawson, 1984; Schaefer, 1957; Gordon, 1954).
		Profit/Rent (T-TC) [1, 2, 6, 7, 8, 11, 13, 14] The literature categorizes profit (i.e. rent) as net revenue; it is a calculation of gross revenue, less total costs (Bonzon, 2000; FAO, 1999; Seijo, Defeo, & Salas, 1998; Lawson, 1984; Shaefer, 1957; Gordon, 1954).
		Quota market value [1, 6, 7, 10] This indicator refers to the average monetary worth of fishing quota within an open market system (Edwards et al., 2006; Pollnac, et al., 2006; FAO, 1999).
		Export value [1, 5, 7, 8] In the Canadian context, Statistics Canada and provincial agencies (e.g. provincial fisheries departments, or independent boards) commonly quantify the domestic value received for fisheries products destined for global markets, by species or aggregated group, at the national and sub-national scale (Charles et al., 2002).
		License market value [1, 7, 10, 12] This indicator refers to the average monetary worth of commercial fishing licenses within an open market system (Pollnac, et al., 2006).
		GDP contribution [3, 5, 7] Gross Domestic Product (GDP) is a valuation of all goods and services produced, within a given scale (CIA, 2003). GDP contribution is the proportion of value for all fishing activity, within the same scale, relative to GDP (Charles et al., 2002).
		Market price of fish (throughout value chain) [1, 5, 10] Market prices represent the post-harvest values paid per unit weight, throughout all levels of the value chain (e.g. various wholesale and retail markets, at various spatial scales) (Angel et al., 2014; Lawson, 1984).
		Proportion of quota value to landed value [1, 6] The literature presents this indicator graphically to display the value gap between annual quota prices and landed value. Edwards and colleagues (2006), and Copes and Charles (2004), discussed that a widening of this gap has led to inequity between fishing communities and generations of licenses holders.
		Ex-vessel price [1, 6] Ex-vessel price is landed value per unit of landed weight (e.g. $/kg or $/lb) - it is the price paid to the harvesters for their landings and represents the first stage of the value chain (Angel et al., 2014; Unal, 2006; Bonzon, 2000; Seijo, Defeo, & Salas, 1998; Lawson, 1984).
		Number of partnerships [1] A partnership is a licensing policy provision, which enables two license holders to combine their licenses on one vessel (Angel et al., 2014; DFO, 2011b).
		Number of business closures [6] Consultants of the MRAG Americas group (2014) describe that

		measuring the number of business closures can indicate the severity of downward economic trends. In the report, the analysts applied the indicator at the regional scale, but it is conceivable to conduct such an analysis at the community scale as well.
		Revenue per operational day [6] A group of analysts in the US employ this indicator as a proxy measure of profitability (where the number of operational days, an attribute of effort, is a proxy for costs), across fleets in several US regional fisheries (MRAG Americas, 2014; Clay, Kitts, & Pinto da Silva, 2014; Kitts, et al., 2011). Over time, the analysts use this indicator, in conjunction with others, to assess the economic viability of fisheries.
		Income per operational day[6] In the context of a fisheries enterprise, the literature defines income as the share of the enterprise profits between the owner and crew. Therefore, income per operational day measures the economic output performance of the enterprise (MRAG Americas, 2014; Clay, Kitts, & Pinto da Silva, 2014; Kitts, et al., 2011).

Examining 4 financial indicators (Table 6; below), I selected income for further testing since the research collaborators repute that local knowledge holders in Grand Manan are able to report on income distribution trends across sectors and generations. Unfortunately, secondary data are unavailable for this indicator. I found that the other financial indicators are not easily interpreted and would require extensive surveying (which was not feasible); thus, I rejected the indicators on these grounds.

Table 6. Indicators which evaluate financial dynamics of fisheries-dependent people.

Relevant Dimension(s)	Relevant Element(s)	Indicators and Descriptions
	Financial information for individuals:	Selected for Testing
Equity and Fairness Economic and	Equitable distribution of benefits and costs	*Income* [1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14] Income (i.e. wage) is the money that an individual earns from either labour (e.g. crew earnings) or capital gains (e.g. an enterprise owner's wage derived from the profits of the firm). Analysts can present the indicator as either gross (before deductions) or net (minus deductions) income (MRAG Americas, 2014; DFO, 2011; Schirmer & Casey, 2005; Charles et al., 2002; Bonzon, 2000).

Financial Health and Well-being	Sustainability of the labour force Financial Viability Fulfillment of basic human needs	Excluded from Testing
		Debt levels [1, 5, 7, 8] In the context of fisheries, analysts represent debt levels as the average amount of money borrowed, by harvesters and firms to finance the costs of fishing, from financial bodies (e.g. banks, loan board, and other creditors). Excessive debt levels can negatively impact the economic resilience of the harvesters and firms (Charles et al., 2002).
		Number of bankruptcies [1, 5] Charles and colleagues (2002) collected data regarding the number of bankruptcies, in relation to debt levels, to indicate forces that have the potential of increasing the vulnerability of harvesters and lowering their resilience.
		Cost of living [1, 3, 12, 13] Schirmer and Casey (2005) categorize this indicator as a measure of money spent to maintain a household (e.g. groceries, mortgage, rent, and other activities). In their social assessment handbook, the researchers described that analysts can compare the distribution of living expenses between fishing and other sectors of the economy, at the community scale. Schirmer and Casey (2005) also state that this indicator can indirectly aid in the assessment of the economic contributions of, and dependency on, the fishing sector.

In table 7 (below), Angel et al. (2014) define the other 10 social and economic indicators as useful when examining fisheries dynamics beyond the traditional production model (Angel et al., 2014; GPCE, 2006; Rockwood, 2006; Schirmer & Casey, 2005; Claridge, 2004; Charles et al., 2002; Dayarathe & Sivakumaran, 1994; Fredericks, Nair, & Yahaya, 1985; Huq & Huq, 1985; Raymond, 1985). However, secondary data are not available for, and LK cannot easily interpret, these indicators. I also exclude the indicators because data collection was beyond the fishery itself; thus, not feasible for this study.

Table 7. Indicators which categorize other social and economic aspects of fisheries beyond the traditional model.

Relevant Dimension(s)	Relevant Element(s)	Indicators and Descriptions
Health and Well-being Equity and Fairness Economic and Financial	Others: Fulfillment of basic human needs Workplace health and safety conditions Stability of access to resource benefits Equitable distribution of benefits and costs Development and maintenance of human capital	Excluded from Testing
		Human population [1, 2, 3, 4, 7, 10, 12, 13, 14] This indicator measures the number of individuals that inhabit a specific area or social unit (e.g. a community) (Rockwood, 2006).
		Migration [1, 3, 4, 7, 10, 12, 13] This indicator assesses the movement of individuals, either into (i.e. immigration), or out of (i.e. emigration), a population, over time (Rockwood, 2006). It is typically measured quantitatively as a rate (proportion of individuals migrating, relative the initial population).
		Education level [1, 3, 4, 7, 10, 12, 13] The literature describes that analysts can measure education level either generically (e.g. number of people with secondary or post-secondary education) or in the context of fisheries (e.g. the number of harvesters with formal or informal training), both quantitatively and qualitatively, at the community scale (Angel et al., 2014; GPCE, 2006; Schirmer & Casey, 2005; Raymond, 1985).
		Social capital [1, 10, 12, 13] Evaluations of social networks are used to qualitatively report on social capital (i.e. cohesive, and cooperative social relationships which produce mutual benefits for members in a community or other social unit) (Schirmer & Casey, 2005; Claridge, 2004).
		Change in housing [1, 3, 12] Generically, researchers can display housing trends with a variety of analytical techniques. For example, they can quantity fluctuations in the number of houses or duration of residency. Analysts can also use perceptions of trends to qualitatively examine the indicator (e.g. increasing, decreasing, or stable housing trends) (Schirmer and Casey, 2005).
		Number of accidents [1, 5, 6] The literature regards the number of accidents as a measure of social well-being within a social unit (e.g. a community) (Angel et al., 2014; Charles et al., 2002).
		Natural capital [5, 8, 10] In the fisheries context, natural capital is the economic valuation of fisheries resources in marine ecosystems. Charles and collaborators (2002) quantified fisheries natural capital as a product of species biomass and inflation-adjusted fish prices.
		Distribution of housing by income [1,2] The quantification of housing distribution by income varies within the literature. Intrinsically, it is a measure of average income per household, and typically segregated by homeowner attributes (e.g. captain, crew, harvester, non-harvester, etc.) (Dayarathe & Sivakumaran, 1994; Fredericks, Nair, & Yahaya, 1985; Huq & Huq, 1985).
		Value of ecosystem services [1, 5] The authors of one article defined marine ecosystem services as the

		services (e.g. ocean transport, nutrient cycling, species habitat, etc.) that ocean and coastal areas provide for humans and aquatic species. The indicator is an annual monetary valuation of these services, by area (km^2) (Charles et al., 2002).
		Depreciation and appreciation of natural capital [5] In one article, the authors described this indicator as the increase (appreciation) or decrease (depreciation), of the value of fisheries natural capital, over time (Charles et al., 2002).

Final Suite of Indicators

The indicator selection process produced a narrow suite of 5 indicators of distribution of fishing benefits (number of licenses, number of vessels, employment, landed value, and income), from the 42 candidate indicators available, which are categorized as suitable for testing within the case fisheries of Grand Manan. I determined that this suite of indicators is suitable to evaluate the outcomes of the selected EAF equity and fairness policy objectives (p. 7) since I screened the set on the basis of the following attributes: distribution, benefits, community, time, and data availability. Although I found that only 5 indicators are suitable, it was the process by which the indicators were developed that is salient. The selection process I used was systematic (i.e. not arbitrary), which enabled the development of the suite of 5 indicators to reflect the EAF equity and fairness policy objectives.

Discussion

In considering the distribution of fishery benefits, (1) there are policy statements and international agreements stating that distribution of benefit is an important consideration, with elements of equity and fairness to be included, (2) it is neglected in measurement/documentation and consideration, and thus needs to be articulated and made measureable, to be considered appropriately in management (Auditor General of Canada, 2011; DFO, 2010; FAO, 2009). Decision makers therefore require outcome-based indicators to assess the extent to which these objectives have been achieved. Although no ideal measure for equity exists, the suite of indicators outlined in this chapter allows assessment of community-level distribution of benefits in terms of unevenness, and distributional change over time. Following the conceptual model by Coulter (1989), I measure how benefits from each case fishery are distributed within Grand Manan. Comparing distributional change over time can determine whether disparity is stable, increasing or decreasing (Schuhbauer, Sumaila, & Chuenpagdee, 2015; Coulter, 1989).

Community level indicators are a key feature of the design of the indicator suite described in this chapter. Although the EAF equity and fairness policy objectives emphasize the need to ensure that fishery benefits are distributed to coastal communities (DFO, 2010), the literature highlights that analysis of community-level impacts is often missing from conventional fisheries management (Berkes, et al., 2014; Berkes & Ross, 2012; FAO, 2009; Ostrom, 2009; Boyd & Charles, 2006). This research

addresses the critical gap of community analysis by exploring various sources of primary and secondary data. My results signify that community-level analysis is attainable through integrated sources, even though constraints of the analysis limited the results to a set of just 5 indicators. Also, there is the potential for future community-level analysis which may draw from the institutional and local knowledge data collection methodologies used in this thesis.

Following the FAO (2009) guidance, this research invited the collaborators to participate during the early stages of the project's design. Thus, the indicator selection process also satisfies recommendations from the literature by developing the suite of indicators to explicitly meet the needs of relevant users (i.e. the industry collaborators) from Grand Manan (Clay, Kitts, & Pinto da Silva, 2014; Edwards, 2008; Boyd & Charles, 2006; Rice & Rochet, 2005). This research triangulated the indicator selection approaches using the Grand Manan case fisheries. Furthermore, the results echo the sentiments of the collaborative research literature – the industry collaborators reported confidence in their positive experience with this research. The collaborative selection process also provided an additional level of scutiny (Yochum, Starr, & Wendt, 2011; Wiber, Charles, Kearney, & Berkes, 2009). . The collaboration enhanced the scientific rigor of the research and enabled more indicators to be selected. Without the collaboration and access to LK, I would only be able to report on two indiactors (the number of licenses and landed value).

The selection process served an additional function through screening the CFRN framework indicators against the global literature. Though the missing indicators are not prevalent in the literature, the screening process provides a level of scrutiny for the CFRN framework.

Limitations

Due to insufficient fisheries data at the community scale, 37 of the 42 candidate indicators were excluded from further testing during the selection process. Currently, Canadian government institutions (e.g. DFO, Statistics Canada, Transport Canada, etc.) and municipalities do not regularly collect data beyond a limited scope of license and landings (i.e. volume and value) statistics by community fishing sector. Employment and unemployment rates are available; however, the institutions do not aggregate the data by fishing sector. The shortcomings stem from the systemic limitations of – and disconnect between – policy, data collection methodologies, and indicator development. These results mirror those found in Boyd & Charles (2006), and Barnett (2018).

While the EAF equity and fairness policy objectives aim to ensure that fisheries resources, access, and other benefits are distributed equitably, the documents offer no definition of equity nor guidance on how to evaluate the success of the policy objectives (i.e. whether equity is achieved). Current institutional collection systems inevitably fail to meet the broad data requirements necessary to evaluate these policy outcomes, since the EAF equity and fairness policy objectives lack guidance for evaluation. By developing indicators explicitly rooted in these policies, this research and other works have made

strides to overcome the evaluative limitations inherent in the EAF equity and fairness policies. However, there exists a dilemma; although new research aims to expand the breadth of indicators and policy analysis, persistent data deficiencies plague these efforts. This research closed gaps found in the secondary data by following recommendations from the literature and exploring additional data from local knowledge holders (Barnett, 2018; Clay, Kitts, & Pinto da Silva, 2014; FAO, 2009; Edwards, 2008; Boyd & Charles, 2006; Rice & Rochet, 2005). However, local knowledge sources also had limitations to the data that could be collected. Thus, it was the integration of multiple data sources that is critical to conduct the distribution of community benefits analysis.

Conclusion

Improving fishery management, and specifically moving towards an Ecosystem Approach to Fisheries (EAF), requires integrating social and economic analyses which are often absent in the conventional management paradigm. The conventional paradigm focuses on a narrow single-species production model to manage fisheries. Canadian and international policy objectives echo the requirement of an EAF and call for analyses which explore the distribution of benefits and community-level impacts. The conventional paradigm overlooks the scale of community at which its policy decisions impact people dependent on fisheries. Community industry collaborators in Atlantic

Canada echo the need for community-level assessment and warn of failed policies and negative community effects in Grand Manan.

With a measure of success, this research applied an adapted selection methodology in an approach to develop indicators based on the needs of policy and affected stakeholders. The systematic approach produced a suite of 5 indicators (number of licenses, number of vessels, employment, landed value, and income) which are appropriate to be tested on three case fisheries in Grand Manan, in the contexts of community, fisheries, benefits, distribution, and data availability (the subject of chapter 3).

Future policy development and research efforts designing outcome-based indicators, which are reflective of policy, may learn from this systematic selection approach. Future efforts should incorporate stakeholder participation at the outset and throughout all research phases (design, data collection, analysis, and reporting) to strengthen scientific validity and the collective research experience. If the policy objective is to achieve equity in community fisheries and across generations, the literature review of this report may offer guidance to policy makers in the subjects of distribution, inequality, and equity measures. To overcome data constraints, I recommend expanding data collection efforts beyond current capacities – echoing calls from the literature. The inclusion of qualitative approaches is key to compliment quantitative analyses. Extensive community surveying (e.g. reinstating DFO costs and earnings surveys) would close data gaps and broaden the

extent of potential analyses. In the context of the CFRN, the framework developers may utilize this analysis and its selection process to broaden their list of indicators.

Overall, this chapter presented a practical application of a selection process for social and economic indicators at the scale of a fishing community. This adapted systemic approach can contribute to Canadian and international advancement towards EAF. This research may help by informing how to incorporate community scale indicators (which measure benefits distributions) into a larger framework.

Chapter 3: Changing distribution of fishery benefits for the community of Grand Manan, NB and the Bay of Fundy.

Introduction

This chapter applies the suite of outcome-based indicators developed in chapter 2 (number of licenses, number of vessels, employment, landed value, and income), to three fisheries (the lobster, herring purse seine, and <65ft mobile groundfish fisheries) in Grand Manan and in the broader Maritimes Region. In response to the need for consideration of distribution of benefits and (or including or especially) attention to equity and fairness considerations which may be considered part of an EAF, the suite of indicators evaluates the changing distribution of benefits in the community's and the region's case fisheries. The context and methods from Coulter (1989) are used to examine the current level of distributional inequality against past levels, and to assess whether/how distribution of benefit is changing over time. Growth in inequality is seen as negative within policy analysis, published literature, and industry stakeholders. "Inequality has created increasing divisions in society, which has led to poverty, class conflict, and other negative social consequences" (Coulter, 1989).

There are various approaches to assess the impact of changes in distribution of benefits, e.g. when the distribution of fishing benefits is stable, predictable, or net positive through time (Schuhbauer, Sumaila, & Chuenpagdee, 2015; Auditor General of Canada, 2011; DFO, 2010; FAO, 2009; Coulter, 1989).

Understanding that there are linkages across multiple scales in social-ecological systems (SESs), the report also offers some assessment and insight into cross-scale connections. The study employs quantitative and qualitative methods and draws on local knowledge (LK) as well as secondary data sources. In this way, the chapter examines the following thesis questions: What data and knowledge are available in the case study relevant to indicators of the distribution of benefits? How has the distribution of benefits changed over time for Grand Manan fisheries and for regional fisheries? What are the broader impacts to the community and region? Is collaboration a useful tool in this research, as is emphasized in the literature?

The lobster fishery

Throughout its history, the lobster fishery (which is exploited by many communities throughout the region, including Grand Manan) has had a variety of conservation strategies implemented. Technical and biological measures began in 1873, when – warned by reports of lobster overfishing – the Department of Marine and Fisheries (predecessor of DFO) implemented measures prohibiting the landing of soft-shelled and berried (egg-bearing) females (DFO, 2011b). In the late 1800's, the department introduced further conservation measures, which placed limits on legal carapace length (CL) sizes and the length of fishing seasons. In 1967, the department applied trap limits and fishing area restrictions to control the level of effort (i.e. input) within the fishery. From the mid 1980s and until the 2000s, additional series of technical and conservation measures (biodegradable escape panels to reduce 'ghost fishing', berried female v-

notching, and further increases in CL) were implemented (DFO, 2011b; Marshall, 2009; Gough, 2007; Allaby, 1984).

Parallel to the technical and biological measures above, the government also engaged in fleet management. In 1968, the department implemented a region-wide limited entry licensing policy with the objective to rationalize (reduce) the fleet for further lobster conservation. Within the licensing provisions, the department allowed: a) license holders to form partnerships with one another (whereby two license holders could fish both licenses under one vessel enterprise, and fish a maximum of 150% of a single license trap limit), and b) an independent core license holder may purchase a second license, which could be 'stacked' with the original license onto their vessel enterprise (the owner can fish 150% of a single license trap limit). The partnership and stacking provisions aimed to further reduce fishing effort; whereby, 50% of the traps from the second license would be removed from the fishery (DFO, 2011b).

Additionally, in 1976, regional lobster fishing participation was further reduced via the "moonlighter" policy. The department created three license categories based on the license holder's level of fisheries dependence: Category A (fully dependent); Category B (not fully dependent and attached historically to the fishery since 1968); and Category C (little or no dependency). Transferability limitations were also applied: Category B licenses expired after the retirement of the license holder and Category C licenses expired after two years of being issued. The department further rationalized lobster

fleets (of those least dependent on the fishery) by implementing a license buy-back program, from 1978 to 1981. To date, DFO has not implemented output control measures (e.g. quota – which limits the harvestable quantity of fish) for this fishery (DFO, 2011b).

A third form of lobster fishery regulation is spatial management. In 1968, the department delineated the spatial boundaries of lobster fishing areas (LFAs) throughout the Maritimes. The LFAs primarily fished by Grand Manan harvesters are LFA 38 and LFA 38B (Figure 2). In LFA 38, the season is open from the second week of November to June 30th, with a limit of 375 traps per single license. LFA 38B, also known as the 'Grey Zone', is a fishing area that exists within LFA 38 and is a disputed territory between Canada and the United States. In 2002, Grand Manan harvesters were permitted to fish in this territory, with licenses issued by DFO. Harvesters fish LFA 38B during a summer-fall season (June 30th - November 6th), also with a limit of 375 traps per license. LFA 37 is a shared territory and fished by LFA 36 and 38 license holders. Area 40 is George's Bank and closed year-round to lobster fishing (DFO, 2013b; DFO, 2011b; Marshall, 2009; DFO, 2007).

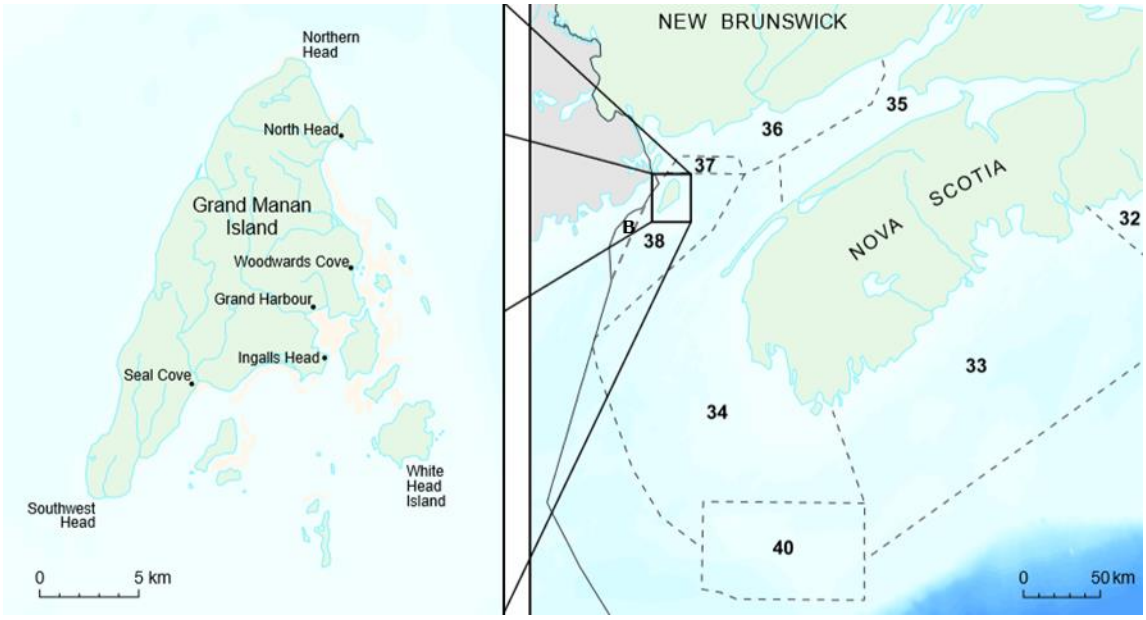


Figure 2. Regional map of Lobster Fishing Areas (LFAs) 33-40 with inset Grand Manan map (Marshall, 2009; DFO, 2007).

The herring purse seine fishery

The herring seine fishery of the Northwest Atlantic Fisheries Organization (NAFO) areas 4VWX (Figure 3), is exploited by various communities including Grand Manan. Throughout its early history, from 1953 to 1969, the purse seine fishing was open access; where no limits existed on the number of vessels that could fish (a measure of effort/input) nor on harvestable quantities (i.e. output). Additionally, Canadian federal and provincial subsidization enabled capacity expansion of the regional herring fleets and processing plants to satisfy the global demand for fishmeal and oil products. These dynamics became problematic as the boom in catch rates in the late 1960's began to subside. In 1970, as a conservation measure to rationalize the fleet, the department of Marine and Fisheries froze the number of licenses issued – limiting the number of

entrants. During this time, the department did not restrict catch rates and over-fishing continued (DFO, 2013c; DFO, 1999; Stephenson et al., 1993).

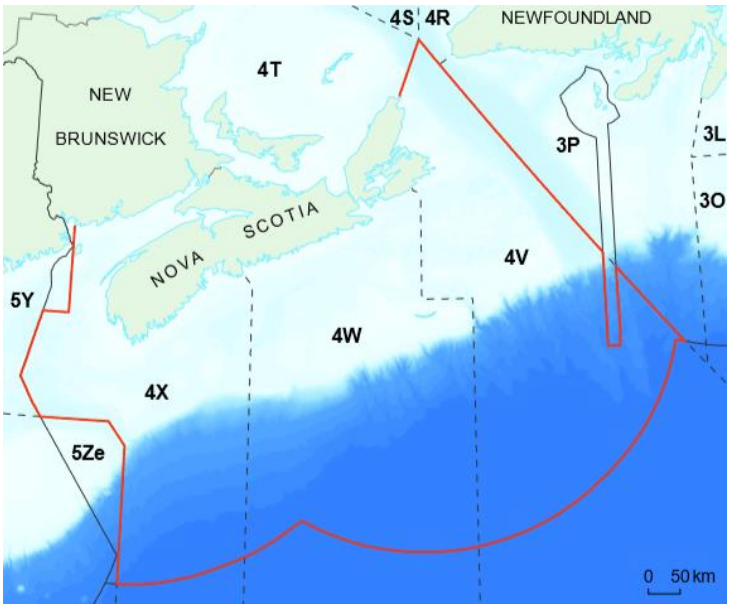


Figure 3. The spatial boundary of the herring purse seine fishery in NAFO 4VWX (DFO Maritimes Region) (DFO 2014a).

In 1972, the regional fisheries management organization, the International Commission for the Northwest Atlantic Fisheries (ICNAF; later NAFO), established national total allowable catches (TACs), through agreements between Canada and other member states. In accordance with bioeconomic theory, the ICNAF set the TAC by a process of stock assessment, review, and upper level management decisions. Also, during this year, a cross-section of industry members and DFO personnel established the first fisheries advisory committee in Canada; known as the Atlantic Herring Management Committee (AHMC) (Iles, 1993; Stephenson et al., 1993).

In 1975, low market prices for herring fishmeal triggered the restructuring 'Bay of Fundy Project', which consisted of selected DFO and industry members (Stephenson et

al., 1993). The project's mandate was to "…discuss the fishermen's request for subsidies for the poor 1975 season, and to examine the problems of maintaining longer term viability of the industry". Approved by the AHMC and then fisheries minister Romeo LeBlanc, in 1976, the project resulted in sweeping reforms. The reforms included:

- The creation of a system to sub-allocate total fleet quota to individual license holders in the region's purse seine sector (known as individual quota; IQs),
- The formation of the Atlantic Herring Fishermen's Marketing Co-operative (AHFMC; whose role was to negotiate herring prices between harvesters and processors, as well as manage the new IQ system), among other reforms (Gough, 2007; Iles, 1993;).

Triggered by the extension of the US coastal jurisdiction, in 1977, Canada followed suit and extended its jurisdiction the same distance to 200nm (known as the Exclusive Economic Zone; EEZ). This period subsequently prompted rapid expansion of large fleets (through private and public investment) which had the matching capacity to exploit Canada's offshore resources. Large harvesting and processing companies, heavily subsidized by provincial governments, emerged to develop these larger offshore fleets. This expansion period enabled these large companies to access large amounts of capital for future investments. This period also sparked a windfall of negative consequences (Gough, 2007; Iles, 1993).

In an effort to further rationalize the fleet, DFO changed the IQ system for this fishery to an individual transferrable quota (ITQ) system, in 1983. The ITQ system allowed for the temporary (lease) and permanent (sale) trade of quota between license holders. In 2007, the herring purse seine fisheries (throughout the Atlantic) – and 11 other fleets –

became exempt from the owner-operator and fleet separation policies (below) (DFO, 2010; Burke & Leslie, 2009). In addition, DFO manages the herring purse seine sector by a series of technical measures (e.g. mesh sizes, gear length, etc.) (Gough, 2007). From 2007 until the present, the stated objectives of the rationalization programs were achieved, and the fleet size reduced regionally. As of 2012, with the sinking of the *Moon Raker*, there are no herring purse seine vessels in Grand Manan. Although the purse seine fishery no longer exists in Grand Manan, it was economically and culturally significant during the island's history. Therefore, it is important (as a research and community objective) to document the way benefits have been distributed away from the community, over time (Sonnenberg, M., personal communication, Sept. 26, 2013).

The <65ft mobile groundfish fishery

The <65ft mobile groundfish fleet (traditionally-based in many regional communities, including Grand Manan) shared a similar management history to that of the herring purse seine fleet. The fishery was open access, from 1948-1972. In 1973, the ICNAF placed an overall TAC on groundfish stocks within and outside of Canada's national jurisdiction (12nm at the time). However, this did nothing to reduce over-capacity in the groundfish fleet, which resulted in overfishing. Consequently, Minister Romeo Leblanc announced a limited entry licensing policy for this Atlantic region fishery, in 1976. Under the Leblanc 'Fishing Plan', which coincided with the expansion of Canada's 200nm EEZ, DFO subdivided the groundfish TAC by fleet sector (between mobile and fixed gears) (Gough, 2007).

Plagued by over-capacity and over-fishing, the groundfish fleets suffered low economic returns. To increase the rate of returns for enterprises, IQs were implemented for the <65ft mobile groundfish fleet in the Maritimes Region, in 1981. During the 1990-1991 season, the fleet switched from IQs to ITQs (Gough, 2007).

Like the purse seine fisheries, the NAFO 4X+5Y <65ft mobile groundfish fleet in the Maritimes Region (Figure 4) was exempted from the owner-operator and fleet separation policies (below), in 2007 (DFO, 2010; Burke & Leslie, 2009). In addition, throughout its history, DFO managed this fleet via a series of mandated technical measures (gear restrictions, minimum fish lengths, etc.). To date, there are still several <65ft mobile groundfish vessels and licenses in Grand Manan; however, all license holders lease their quota (primarily to vessels in Southwestern Nova Scotia) and do not direct for groundfish species using this gear type (Sonnenberg, M., personal communication, Sept. 26, 2013).

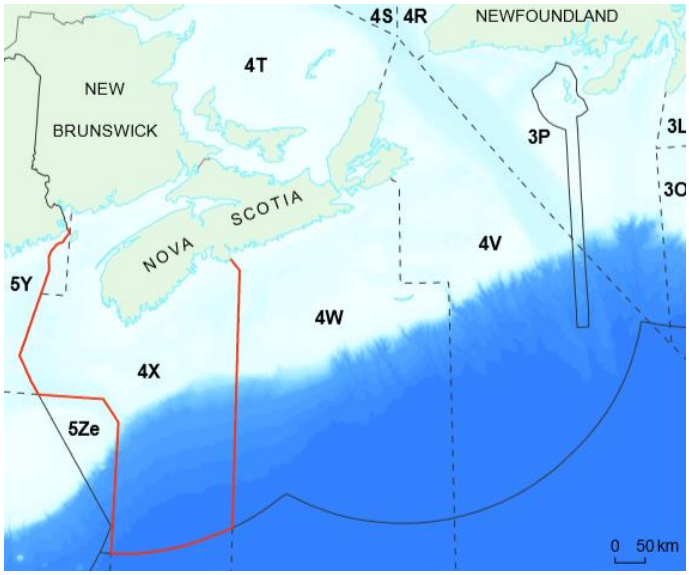


Figure 4. Highlighted in red, the 4X+5Y fishing area is located within the Maritimes Region (DFO, 2014a).

Broad Policy Issues

Owner-operator and fleet separation policies

In 1978, Fisheries Minister Romeo LeBlanc first introduced owner-operator and fleet separation policies to restrict corporate ownership, and to ensure that the benefits of Canadian inshore fisheries flow to the sector's license holders and their coastal communities – a community-centric management model (DFO, 2010). He presented the policies, in a statement following the 1977 expansion of Canada's coastal jurisdiction to 200nm. The owner-operator provision requires license owners to fish the license personally. The fleet separation policy precludes the corporate ownership of 'new' licenses for <65ft vessels (DFO, 2003; DFO, 1996). DFO formalized the policies in the 1985 Commercial Fisheries Licensing Policy for Eastern Canada (owner-operator policy – general conditions of licensing, section 2.4.2; and fleet separation policy – section 2.4.3)

(DFO, 1985). However, DFO did not fully implement the owner-operator policy, throughout Maritimes Region, until 1989 (Gough, 2007).

In 1996, DFO ratified the above policy, with two new clauses for the owner-operator and fleet separation policies. Under the owner-operator policy, “license holders who have previously (prior to 1996) designated an operator for one or more of their vessels could continue to do so under a grandfather clause” (DFO, 1996). Under the fleet separation policy, corporations which have held licenses for vessel less than 65 feet prior to 1979 could continue to hold these licenses and buy/sell these licenses with other ‘pre-1979’ corporations (DFO, 1996).

Some corporations (or individuals), that did not meet the exclusion criteria for the owner-operator and fleet separation policies, found an alternative way to buy licenses within the inshore fleets (lobster and others). Such firms (or individuals) have been able to buy the controlling ‘beneficial interest’ of a license by arranging a civil contract (known as a controlling or ‘trust’ agreement) between the firm (or individual) and a license holder. Within these controlling agreements, the firm (or individual) provides the financial capital to buy the license, and the ‘legal title’ of the license is ‘entrusted’ in the license holder’s name. Consequently, the license holder is indebted to the financier for the license cost. The ‘beneficial interest’ of the license (i.e. most of the revenues gained from fishing) flow toward the financier through debt servicing by the license holder (DFO, 2010; DFO, 2003).

These controlling agreements contravene the fleet separation and owner-operator policies (DFO, 2010). Between 1999 and 2004, DFO held an extensive industry consultation known as the Atlantic Fisheries Policy Review (AFPR). Included within the exploration of a comprehensive policy framework of the AFPR was an investigation of the extent of controlling agreements within Atlantic Canadian inshore fleets, and the problems surroundings these arrangements (DFO, 2003). On April 12, 2007, following the AFPR, DFO announced a policy to Preserve the Independence of the Inshore Fleet in Canada's Atlantic Fisheries (PIIFCAF). The PIIFCAF measures stipulated that any core (full-time) license holder were to declare that their license is not financed through a controlling agreement; consequently, these licenses became classified as independent core (IC) licenses. Under the PIIFCAF measures, if any core license holder did not declare their independence within a 7-year period, or if officials found evidence of third-party control via 'trust' agreements, these license holders would not be able to re-issue their license after the grace period (April 12, 2014). In other words, companies and license holders had 7 years to dissolve these contracts. On July 24, 2015, federal Fisheries Minister Dominic Leblanc continued DFO's commitment to honour PIIFCAF by strengthening the enforcement of fleet separation and owner-operator policies (DFO, 2015a, Allain, M., personal communication, Jan. 23, 2013; DFO, 2010; DFO, 2003; Gough, 2007).

Aboriginal considerations

In 1990, the Supreme Court of Canada R. v. Sparrow ruling held that aboriginal rights have a priority to fish for food, social, and ceremonial (FSC) purposes (DFO, 2015b). In 1994, DFO created the Aboriginal Fisheries Strategy (AFS) in response to the Sparrow decision to manage the FSC fishery and provide funding to eligible aboriginal community groups via bi-party agreements. DFO also created the Allocation Transfer Program (ATP) under the AFS. The ATP "…facilitates the voluntary retirement of commercial fishing licenses and the issuance of communal licenses to eligible Aboriginal groups and includes funding for the purchase of equipment, such as vessels and gear necessary for Aboriginal groups to fish these licenses." (DFO, 2018). Under the ATP, DFO bought back several commercial LFA 38 licenses in Grand Manan and reissued the licenses to Tobique First Nation, a Maliseet community in New Brunswick (Sonnenberg, M., personal communication, Sept. 26, 2013).

Methods

Measuring distribution

I use Coulter's (1989) distribution theory terminology of units and components to categorize the application of the suite of indicators to the case fisheries of Grand Manan and the broader region. Additionally, the indicators are bound by various attributes (i.e. metric options). For example, the attributes include segments of time (e.g. 1960s to 2014), and unit quantities for each indicator (e.g. 50 licenses), relative to each fishery

component. The collaborators in the research recommended the retrospective period begin in the 1960s since it represents the community's fisheries prior to major policy interventions, and a living oral history still exists for this period. I also include analysis of the driving factors of distribution and cross-scale linkages, using social-ecological systems (SESs) and community resilience theory.

There are dozens of approaches to measure distribution of fisheries benefits. I selected the following five methods based on their prevalence in the literature, their capability to satisfy both the conceptual and technical criteria in Coulter (1989), their capacity to assess both relative and absolute inequality, and their interpretability of changing inequality within case study systems:

1. Perceptions of trends (i.e. local knowledge of distribution patterns)
    - Local knowledge (LK) holders described how the distribution of benefits changed in relation to the community of Grand Manan, and among the case fisheries regionally. I collected the data using qualitative research techniques (cross-sectional, semi-structured interviewing) and the participants described distribution patterns changed over the period. This is a relative inequality measure since all fisheries sector components are not accounted for (Coulter, 1989).
2. Proportional analysis of stacked linear trends
    - This quantitative approach stacks the total unit metrics for the benefit measured (historical fishery license and landed value data), by the community case fisheries, over time. These trends depict the relative change in distributional inequality.
3. The Gini Coefficient
    - The Gini Coefficient is an absolute quantitative measure of inequality and calculates the relationship between the total proportion of units

(e.g. number of licenses) and the total number of components (e.g. the number of LFAs – presented below), which includes null components (those receiving no share). The Gini Coefficient ranges between 0 (perfect equality) and 1 (maximum inequality, where one component receives 100% of the shares).

4. The Lorenz Curve

    - The Lorenz Curve is a graphical representation of the Gini Coefficient. Creating a Lorenz Curve involves plotting the cumulative proportion of 'components' (e.g. fisheries sectors or areas) on the x-axis, against the cumulative proportion of 'units' (e.g. money or the number of licenses) on the y-axis.

5. Spatial distribution analysis

    - To display distributional changes in the case fisheries geographically, this visualization tool involves plotting the quantitative data from the proportional analysis on a map.

Primary data: Local knowledge

This analysis draws on data collected using a mix of qualitative and quantitative methods. Qualitative research involves a range of techniques employed by the observer(s) to collect data and information by observing and/or interviewing a sample population to collect the interpretations, meanings, and explanations of the subject at hand, as perceived by the participants (Denzin & Lincoln, 2011). Qualitative data can provide a foundation to compare supplemental quantitative data (i.e. concurrent design; ground-truthing). Using a combination of both data types can provide a better understanding of the research topic than either method could alone. Cross-referencing (i.e. triangulating) the datasets can also provide analysts with a powerful verification tool and increase the study's validity. Furthermore, qualitative data can inform and

explain trends found in concurrent quantitative datasets (Barnett, 2014; Denzin & Lincoln, 2011; Gerring, 2007).

From September, 2013 to December, 2014, I designed the primary data field survey via a series on iterative collaborative focus group discussions with industry, academic, and government partners. I also adapted protocols from similar studies in the literature (Barnett, 2014; Paterson & Kainge, 2014; Foley, Mather, & Neis, 2013; Parlee, 2011; Elo & Kyngäs, 2008; Hancock, 1998). Prior to the recruitment and interview phases, I received Research Ethics Board (REB) approval from Saint Mary's University (SMU) in Halifax, NS (February 5, 2014). I compiled this research explicitly in accordance with the REB standards. As a REB requirement, I afforded participants the opportunity to give free and informed consent by providing them with operational procedures (in writing and read aloud).

Since a range of active and inactive harvesters constituted the case fisheries, and information regarding these participants is confidential, I collaborated with the Grand Manan Fishermen's Association (GMFA) to assist with recruitment (from February 5, 2014 to March 31, 2014). I also used snowball sampling to identify additional participants. As the process involved use of non-random sampling, sampling errors could not be calculated.

I maintained confidentiality by coding all participant information and using pseudonyms when referencing participants in text. All participant data are stored on a password-protected computer within a locked facility. All research collaborators who have had access to participant data are bound by signed confidentiality agreements.

I conducted interviews from March 31, 2014 to April 14, 2014 in Grand Manan. Each interview was approximately 2 hours in duration. I identified 42 potential participants based on their knowledge of Grand Manan and the regional fisheries. A total number of 21 individuals agreed to participate in the survey. This subpopulation consisted of equal representation from the three case fisheries. All 7 lobster participants identified as active local license owner-operators. 5 herring participants identified as local retired harvesters (i.e. resident group), and I also interviewed 2 knowledgeable non-residents. For the mobile groundfish fishery, I interviewed 6 resident active and inactive license holders, along with 1 non-resident. I included non-residents in the survey based on their merits that each formerly worked directly with their respective fisheries and were knowledgeable of trends in Grand Manan. I separated their response rates accordingly. The entire group represents 3 generations, with a range of experience from 10-50 years, with several participants also having extensive experience in the processing, distribution, and government sectors.

In 2014, I administered the semi-structured, cross-sectional survey in face-to-face and over-the-phone interviews. The survey consisted of 22 opened-ended questions (Appendix B) regarding the following general themes:

- Personal history with the fishery.
- Knowledge of how the case fisheries trends changed for each indicator over time (1960s to 2014), within Grand Manan.
- Knowledge of changing distribution patterns, across scales (e.g. groups of individuals, the local community, and the region).
- Perspectives on the drivers of change (e.g. policies which manage the fisheries, and other influencing factors).

I recorded and transcribed all interviews. I afforded the participants the opportunity to change or recant their responses by reviewing the transcriptions with them. I synthesized and categorized the transcripts by fishery, common theme responses, participant groupings, and quantified response rates. The quotations used reflect common perceptions of distribution patterns and insights into the drivers affecting distributional change.

Secondary data: Community Scale

It should be noted that secondary data at this scale was only available for the number of licenses and landed value indicators. The Licensing Division of DFO in the Maritimes Region provided three excel datasets for the three fisheries sectors and included fields for active number of licenses grouped by year, community, and LFA. DFO only collects data for the village of Grand Manan (excluding Whitehead Island) – the data are not aggregated by township. Regarding the lobster data, licenses in LFA 38 and LFA 38B (the 'Grey Zone') categorize the local fishery. I display the distribution of active licenses, by

each fishery case sector, in Grand Manan over time within a stacked linear trend graph for years 1998 to 2012 (based on the common available time series for the fisheries).

I also received three datasets from the Commercial Data Division of DFO (Maritimes), regarding landed nominal (uncorrected) value and including fields displaying year, community, and (in the case of the mobile groundfish sector) harvested species. This report focuses on Atlantic cod (*Gadus morhua*) – the GMFA regarded Atlantic cod as the primary commercial groundfish species, for Grand Manan. I present the distributional change of landed value, for each community fishery, within a stacked linear trend chart for the years 1980 to 2012. I corrected nominal value into constant 2012 dollar using the following equation: I first divided the consumer price index (CPI) of 2012 by the CPI of the year to be adjusted and the multiplied the quotient by the nominal value of that year.

Nominal year to be adjusted *(CPI 2012/CPI year to be adjusted)

Secondary data: Regional Scale

Within the following four analytical techniques, I used the complete lobster license dataset provided by the Licensing Division of DFO. The selected methods assess the distribution of active licenses across the regional LFAs for the years 1998 to 2014. The first method presents the data in a stacked linear trend graph.

I calculated the Gini Coefficients and plotted Lorenz curves for three equal segments across the above period. I plotted the Lorenz curves as a cumulative proportion of the number of LFAs (x-axis) in relation to the cumulative number of active licenses shared across the regional LFAs (y-axis). The curves, in each case, are compared to a straight line that reflects perfect equality (which would be the case if each LFA shared an equal number of licenses), to assess the extent of inequality. The more the Lorenz curve deviates from the equi-distribution (straight) line, the greater the degree of inequality. Again, the Gini Coefficient is a quantitative expression of the Lorenz curve and ranges between 0 (perfect equality) and 1 (maximum inequality; where, in this case, the license holders of one LFA possess 100% of the licenses). I calculated Gini Coefficients using the following equation (where *n* represents the number of LFAs in the regional fishery, and *y* represents the number of active licenses held within each LFA) (Haas, 2016; Coulter, 1989):

$$G = \frac{1}{2n^2 y} \sum_{i=1}^{n} \sum_{j=i}^{n} |y_i - y_j|$$

I calculated and presented the change in distribution across the fishery's LFAs spatially for the same period. First, I calculated the percentage point change in the proportional share of active licenses, for each LFA. Then, using an incremental color spectrum (of 5% intervals for each color), I plotted the results (by corresponding counties which held the licenses) on a Maritimes region map. The blue spectrum represents positive change, the red spectrum depicts negative change, and white illustrates no change.

For the years 1979 to 2011, I also illustrated the distribution of landed value (again adjusted to 2012 CAD), throughout the regional lobster fishery. I used DFO commercial data to calculate and plot: stacked linear trends, Gini Coefficient, Lorenz curves, and spatial data. Since DFO withheld mobile groundfish and herring seine data during periods when less than 5 licenses were active in a given community, I was unable to plot Gini Coefficients, Lorenz Curves, and spatial distribution trends for these fisheries.

Using a stacked linear analysis for the mobile Atlantic cod fishery, I calculated the distribution of licenses across 5 categories throughout the region for the years 1998 to 2013. Three categories display the license trends for Grand Manan, Pubnico, NS (currently the community with the largest share of licenses), and Yarmouth, NS (currently the community with the second largest share of licenses). To protect individual and enterprise privacy, DFO does not release license and commercial data for any communities which contain less than 5 licenses holders. Thus, for any community matching this privacy parameter (for any years of the dataset), DFO aggregated the licenses into a fourth unspecified category. For ease of analysis, I aggregated all remaining NS licenses into a fifth category. Secondary herring data are considerably constrained; thus, I did not analyze the data at this scale.

Results

Change in fisheries benefits to Grand Manan

The participants highlighted the historical chronology documented in the literature for the case fisheries. Prior to the sweeping management changes of the late 1960s and onward, the three key fisheries (lobster, herring seine, and mobile groundfish) were open access in Grand Manan. During this time, the participants stated that fisheries in Grand Manan were more diverse than today. They indicated that the community, its people, and their culture enjoyed a period of resilient prosperity which was driven by diverse and robust fishing fleets of the three sectors, which were traditionally independently-owned. Owners and their operations benefited from the revenues generated, crews benefited from gainful income and employment opportunities, and the local economy benefited from a healthy economic multiplier effect derived from the diversified economic activity.

The general perception from participants reiterated that resource scarcity from overfishing triggered conservation policy interventions, from the late 1960s - onward. The participants argued that the quasi-property rights system of ITQs, implemented by DFO in 1976 and 1990 for the herring seine and mobile groundfish sectors (respectively), reinforced downward economic pressure on the fisheries – a compounding multiplier effect where a reduction in one sector of the economy can negatively affect other sectors. The participants said that quota restrictions constrained harvester landings and

reduced enterprise revenue – for those who did not purchase additional quota. The majority of Grand Manan enterprises within these two local sectors became financially non-viable as costs rose, over time. Participant data indicates that Grand Manan herring seine operations ended in 2012, after the sinking of the last purse seiner, which was not replaced due to financial non-viability. Joan Marshall (2009) wrote that the community's mobile groundfish fleet ceased operations after 2005, also due to financial non-viability. According to the participants, these dynamics and the open transferability rules of the ITQ system enabled extensive trading of licenses, quota, and vessels, and contributed to increasing local disparity and regional concentration of the two fishing fleets. Over time, the community lost several benefits (i.e. revenue, income, and employment) derived from these sectors, which are now concentrated elsewhere. Power dynamics also shifted. These changes are highlighted by many of the participants in this research, as the following quotes indicate.

Participant #24 noted,

> "As the allocation (ITQs) shrank, based on reductions in the TAC, the expenses of the enterprise become too great and, thus, the business becomes financially non-viable. As a result, independent harvesters (were) forced to sell or lease their remaining quota, as it is not viable to fish themselves".

Regarding the herring seine industry, participant #5 said,

> "The fleet got smaller over the years. At first purse seiners used to be individually owned and operated, but over time these individuals sold (vessels and licenses, with attached quota) to companies. This was strongly related to the advent of individual quotas (IQs), in 1976. Companies were better financed than individuals and, as the over-the-side-sales faded, the market became restricted and the companies (in particular processing companies) dictated the markets (who and where the harvesters could sell to). Basically, individual fishermen had control (of access, ownership, and profits), and the companies

> convinced the fishermen that they would manage the marketing of the product. Over time, individual fishermen lost control of the industry as large corps bought up shares of the industry".

Furthermore, participant #20 recounts,

> "When the seiners left, there were 38 (harvesting) jobs that were lost…They were $50,000-$70,000 (per annum) jobs for the crew…(This) had a devastating effect on other sectors; (transportation), processing, and other services".

According to participant #12, mobile groundfish fleets in Grand Manan suffered a similar fate,

> "In the 1960s, there used to be 8-10 draggers (in Grand Manan) that carried 4 crew on average and, over time, that became less and less as the draggers were sold off".

Participant #12 argued,

> "So, I think that's why the ITQ came in - so you could get the quota from two or three boats to make it viable. But somewhere along the line it went from someone owning enough quota to make it viable, to someone owning all the quota".

Recent participant data from 2014 and secondary data (below) illustrates that the number of fisheries serving Grand Manan has become much reduced over the period examined in this research. Currently, of the three key Grand Manan fisheries, only lobster sector vessels, and their associated licenses, are still active. Over time, the community, its people, and their culture collectively lost access and associated benefits (revenue, income, and employment) to two of its three main fisheries.

Participant #34 stated, "The whole economy (of Grand Manan) is dependent on one thing – lobsters". The research collaborators from the GMFA also echoed this insight: "dependence on lobster has increased, reducing (the community's) resilience".

Participant #13 predicted a potential associated hazard with the loss of diversified landed value, the increase dependence on a single species, and the subsequent reduction in community resilience. He said, “If the lobster fishery goes the same as the others that would be the death of the island”. The participant is alluding to concerns over perceived benefit losses in the community’s lobster industry – which I present in the regional dynamics section below. Participant #5 said the loss of landed value triggered an economic downturn multiplier effect within the community, “The trickle down (economic multiplier) effect has become smaller and smaller over the years” (Field Interviews, 2014).

Table 8 depicts the participants’ perception of changes to the suite of selected benefits, through the period from the 1960s to 2014. The participants reported that access to key fisheries in Grand Manan became concentrated, over time. All herring seine licenses were sold to companies outside of Grand Manan, and only a few inactive mobile groundfish licenses remain in the community. The community also lost lobster licenses, but this was to a relatively lesser extent, in comparison.

According to Participant #19 from the lobster sector,

> “The licenses are pretty well distributed around the community, other than the 4 licenses that are owned by (a SWNS company). I don’t blame the business for buying (Grand Manan) licenses; he’s just a business man. I blame the federal government for letting it happen. The (SWNS) company owns two (GM licenses), and then there’s two more (GM licenses) that they designate operators and designate vessels, and just so happens that the vessels are owned by (the SWNS company). And they (the SWNS company) also have 6 native licenses that they operate in LFA 38.”

Participant #7 from the herring seine industry argued,

> "I'd like to go back to see your (study's) number of vessels and (license) ownership…in the middle 1960's, in Grand Manan, there was 14 purse seiners. Now (2014) they're down to nothing - all (licenses and vessels) are company-owned now."

Participant #19 from the mobile groundfish sector reported,

> "I still have a groundfish license, but I would have to buy (lease) quota (to fish)"

Table 8. Participant response rates and trend perceptions for the case fisheries, from the 1960s to 2014.

	Lobster Fishery		Herring Purse Seine Fishery			<65ft Mobile Groundfish Fishery		
Indicator	Responses (N=7)	Perceptions of Trends	Responses (N=7)		Perceptions of Trends	Responses (N=7)		Perceptions of Trends
	Resident		Resident	Non-resident		Resident	Non-resident	
Number of Licences	7	Decreased (to a relatively lesser extent)	5	2	Decreased (to zero)	6	1	Decreased (moderately)
Landed Value	7	Increased	5	2	Decreased (to zero)	6	1	Decreased (to zero)
Number of Vessels	7	Decreased	5	2	Decreased (to zero)	6	1	Decreased (moderately)
Employment	5 2	Increased No Growth	5	2	Decreased (to zero)	6	1	Decreased (to zero)
Income	4 3	Increased No Growth	5	2	Decreased (to zero)	6	1	Decreased (to a relatively large extent)

The secondary data representing change of access (Figure 5; Appendix C) corroborates the participant survey data and shows that the total number of licenses for the three Grand Manan fisheries declined from 155 in 1998 to 130 in 2012. Also, the loss of access was particularly extensive for two of the fisheries. The community's herring seine fishery lost all its access (from 6% to 0%), and the mobile groundfish fishery lost 25% of its

license share (from 8% to 6%). As a result, the lobster fishery became even more dominant, with its share of the community's fishery access rising from 86% to 94% over the comparative period (DFO, 2014b). Although the lobster fishery lost many licenses, the remaining licenses represented a larger proportion when compared to the total number of fisheries licenses in the community. Thus, there was a loss of diversified community fisheries access and an increasing dependence on the lobster fishery.

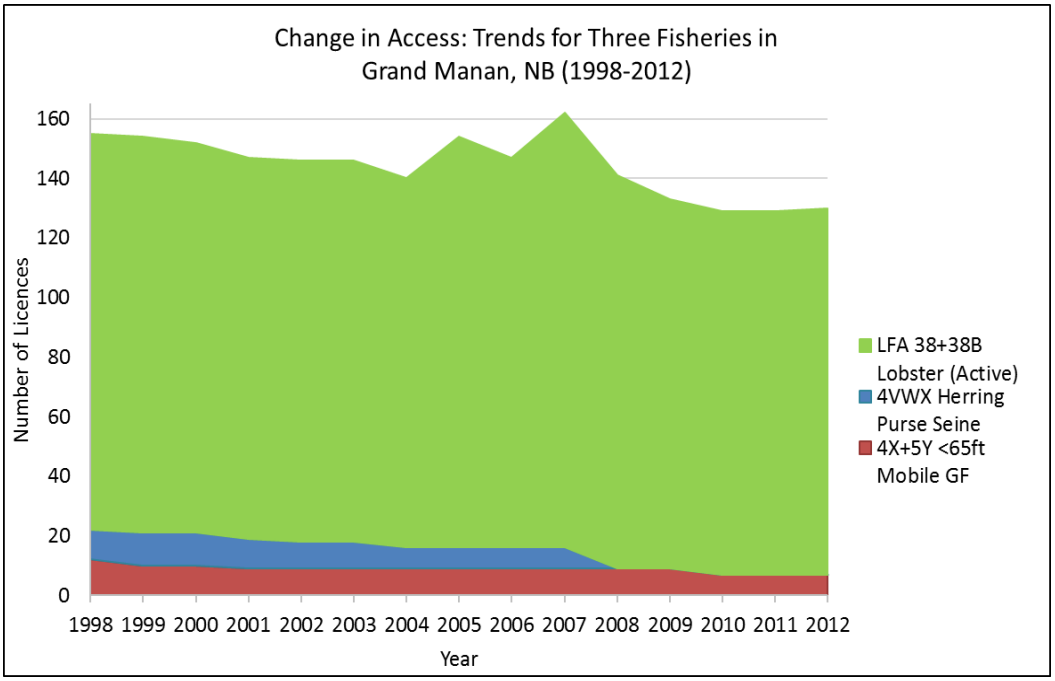


Figure 5. Change in the distribution of fisheries licenses (1998-2012) for the lobster, herring purse seine, and mobile groundfish fisheries in Grand Manan (DFO, 2014b).

According to the primary data, the manner by which fishery benefits flowed to the local Grand Manan economy – in the form of revenues generated from the key fisheries – changed, over time. 7 participants reported that landed lobster value increased from the

1960s to 2014, while the remaining 14 respondents argued that landed herring purse seine and mobile groundfish values sharply declined to zero, over the same period.

Figure 6 (below) verifies the primary data and displays a widening gap of fisheries revenue contributions across the fisheries. In 1980, the herring seine fishery contributed 65% of the total value of the fisheries, and the lobster fisheries contributed the remaining 35%. DFO did not release groundfish data for any years where there were less than 5 licenses active in the community. The available data (Appendix D) shows that the mobile groundfish fishery generated a meagre share of total landed value from 1985 to 1992 and recorded its highest share of 7% in 1988. The community's herring and mobile groundfish fleet operated at distances away from the coastal waters of Grand Manan, and thus regional landing dynamics have overshadowed the real revenues attributed to these local fleets.

After 1997, the data shows that the lobster fishery is the only fishery in this comparison that generates landed gross revenues in Grand Manan, and that these revenues dramatically increased in the later period (Bank of Canada, 2014; DFO, 2014c). Regarding only these case studies, the figure shows that growth in landed lobster value is far greater than the losses in the other fisheries.

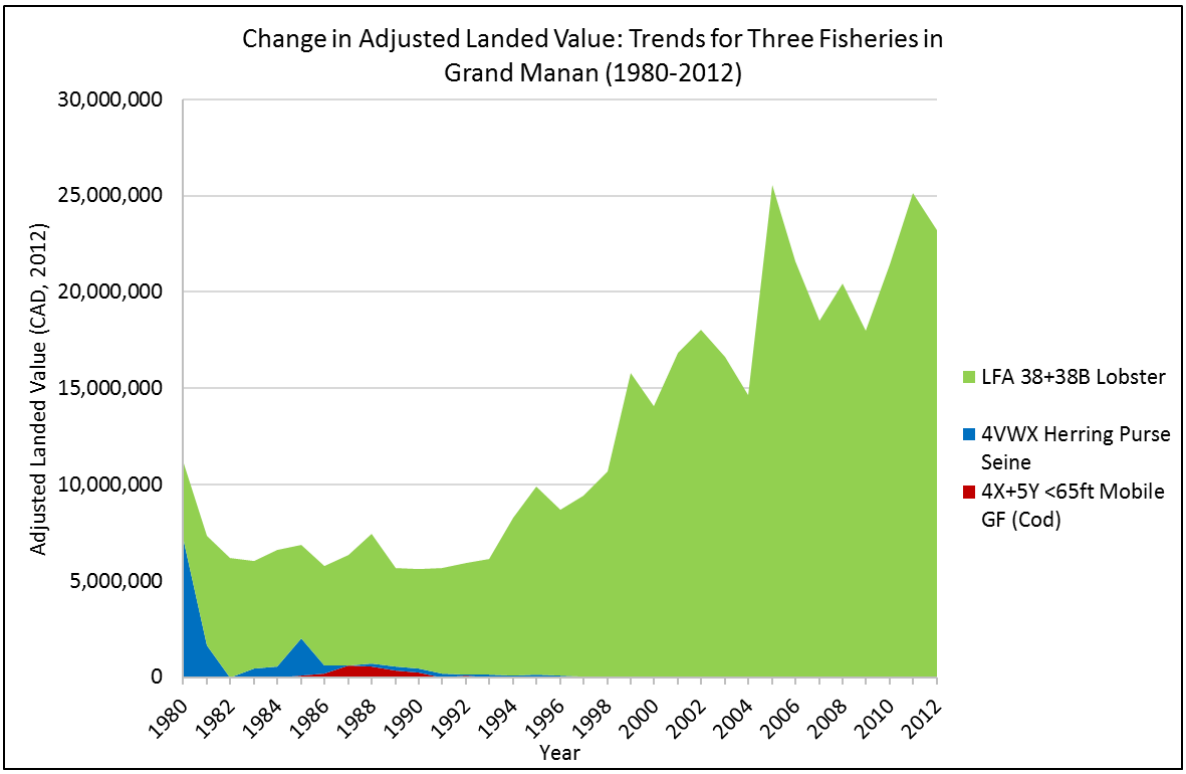


Figure 6. Change in the distribution of landed value (1980-2012) for the lobster, herring purse seine, and mobile groundfish fisheries in Grand Manan (Bank of Canada, 2014; DFO, 2014c)

All 21 surveyed participants reported that the number of vessels decreased from the 1960s to 2014 (Table 8; above). Noted previously, the participants attributed reduction of Grand Manan vessels to the loss of fisheries access (i.e. licenses). Participant #17 reported the decline in vessel numbers perpetuated negative community effects: “There would have been some economic loss to the community (downturn multiplier effect) since there would have been less service on a lower number of vessels” (Field Interviews, 2014).

The employment survey results (Table 8; above) concur with the previous data: the community saw employment disparity increase across the fisheries. Participant #9 explained, “There isn’t the same amount of work as there used to be”. 14 participants noted Grand Manan completely lost jobs in the herring seine and mobile groundfish sectors, while 7 harvesters explained that

the community's lobster industry experienced relative or stable employment growth. Participant #13 stated that these losses equated to a deficit of something greater, "It takes the livelihoods out of the communities" (Field Interview, 2014).

Participant #34 offered insights into the main driver which perpetuated the harvesting sector's labour disparity, resulting in downturn throughout the local economy (Table 9). He describes how, from 1963 to 2014, losses of physical capital (i.e. licences, quota, and vessels) directly resulted in employment loss in the harvesting sectors, and reinforced physical capital and employment losses in the community's post-harvest sector. Two other participants confirmed the reduction and shift of the community's processing sector. Participant #20 said, "(Our) family company (involved in harvesting, processing, buying, and transporting) transitioned from herring, to groundfish, (and) to lobster". Participant #28 reported, "We were involved in the groundfish fishery until 2010…lobster have been our main thing for the (past) 3-5 years". The wave of business closures rippled downward throughout the local economy and negatively impacted physical capital and employment in the manufacturing and service sectors. Participant #8 noted the same perspective, "Employment was lost in the peripheral jobs".

Table 9, constructed with data from Participant #34, also suggests that the local lobster fishery remained resilient, despite negative vessel trends. The harvester's data notes that while the number of vessels approximately decreased by half (approximately 130 to 65), the average number of crew per vessel approximately doubled from 1.5 to 3. Thus, the increase in labour per vessel buffered against the decline of lobster vessels.

The data from participant #34 illustrates that for Grand Manan fisheries overall, approximately 803 people lost their jobs between 1963 and 2014 - which is equivalent to 51.7% of the community's current workforce (Statistics Canada, 2012). Although these numbers are approximations, the participant's assessment aligns with the other results, and depicts the community-level downturn which stems from losses in fisheries access, revenue, and physical capital. The harvester also explained that the large employment loss had devastating effects on the current size of the Grand Manan labour force, "If you tried to start any of those businesses today, you couldn't get the manpower… because there's nobody here". (Field Interviews, 2014).

Table 9. Comparison between the number of privately-owned businesses and employment, in Grand Manan, between 1963 and 2014 (Participant #34, personal communication, April 6, 2014).

1963 – Grand Manan (Excluding White Head Island)			
Employment Sector Segments	Number of Businesses Units	Number of people Employed Fulltime per Business Unit	Total number of people employed by sector
Herring Carriers (Postharvest; PH)	38	2	76
Purse Seiners (Harvesting; H)	14	5	70
Groundfish Trawlers (H)	15	4	60
Lobster (H)	130	1.5	195
Pulp Mill (Manufacturing; M)	1	75	75
Sardine Plants (Processing; P)	2	80	160
Groundfish Plants (P)	4	12	48
Smoked Herring Stands (P)	16	13.5	216
Car Dealerships (Service; S)	8	1	8
Garages (S)	7	3	21
Stores (S)	21.5	3	65
Herring Pumpers (PH)	20	2	40
Estimated employment numbers for a cross-section of the local economy	N/A	N/A	1,034
2014 – Grand Manan (Excluding White Head Island)			
Herring Carriers (Postharvest; PH)	0	0	0
Purse Seiners (Harvesting; H)	0	0	0
Groundfish Trawlers (H)	0	0	0
Lobster (H)	~65	~3	195
Pulp Mill (Manufacturing; M)	0	0	0
Sardine Plants (P)	0	0	0
Groundfish Plants (P)	0	0	0
Smoked Herring Stands (P)	0	0	0
Car Dealerships (Service; S)	0	0	0
Garage (S)	2	3	6
Stores (S)	~10	3	~30
Herring Pumpers (PH)	0	0	0
Total	-	-	231
Estimated change of employment numbers for a cross-section of the local economy	N/A	N/A	-803

Lastly, the primary data depicts that the variety of sources which yield benefits for Grand Manan fisheries contracted. These results support the findings from the secondary data. Participant #5 said, “The disparity grew over time”. According to the 14 herring seine and mobile groundfish survey participants from the 1960s to 2014, the industries experienced severe declines in total incomes. A mobile groundfish harvester (participant #33) reported a driver of income disparity and notes the extent of the disparity,

> “2-3 big companies have it all and instead of a thousand workers in small coastal communities, you have a hundred working at lower wages. They make millions while you have nothing”.

In comparison to the other two fisheries, 7 lobster harvesters noted a relatively positive situation. Participant #19 said that his company paid an increase in wages to an increasing number of labourers, “In the Mid-1990s to 2014, we had an extra guy paid a day wage”. On the other hand, another lobster fisherman (participant #34) provided a different perspective, “…fishermen today would make relatively the same or less than fishermen years ago, who fished with less effort”. Although the latter harvester describes muted income growth within the lobster fishery, the result is still better than those of the other sectors.

Regional Analysis

The Lobster Fishery

Elaborating on their previous responses, the surveyed lobster harvesters reported that several Grand Manan lobster licenses were redistributed to communities in Southwestern Nova Scotia and mainland New Brunswick. According to 6 harvesters, a Southwestern Nova Scotia (SWNS) company established trust agreements with several Grand Manan licenses holders. The group

argued that these arrangements circumvented fleet separation and owner-operator policies. The harvesters also stated that several Grand Manan lobster licenses were transferred to an aboriginal community group in mainland New Brunswick via the federally funded Allocation Transfer Program (ATP).

Participant #22 articulated his concern over the impact of the loss of lobster fishery access on the community. According to him, the revenue generated from one license, along with the partial revenue of a second license, accounts for approximately 1% of the Grand Manan economy. He said, "…when you're talking about one license being gone, it's not like it's nothing. And when it's 12 licenses that's gone, or 13…".

Furthermore, participant #25 described his insights into the resulting knock-on effects of the loss of fisheries access in Grand Manan,

> "Those crews are coming from Nova Scotia. And that's good for Nova Scotia, but it's not good for New Brunswick. They buy rope in Nova Scotia, they buy their fuel in Nova Scotia, and the lobsters go back there. So, instead of getting 4 direct jobs from the lobster licenses, and about half a dozen indirect jobs, there's nothing – except a (Grand Manan) guy getting his lease fee".

The regional secondary license data results differ from that of the harvesters (to be discussed later). Figure 7 shows a generally stable distribution trend with a few areas improving there share (Appendix E). After the inclusion of LFA 38B (the 'Grey Zone'), Grand Manan harvesters received an incremental addition of 40 licenses, from 2002 to 2014. These licenses buffered the community against the losses of 28 licenses experienced in LFA 38, throughout the period. In comparison to the regional change of licenses, the community gained 1 percentage point and currently possesses 7% of the total share of licenses. Tobique First Nation (located in Victoria

County) also added 16 licenses, throughout the period, yielding a gain of 1 percentage point; the community currently shares 1% of the total fisheries access. Interestingly, although LFA 34 (red) lost 62 licenses, it gained 1 percentage point and possesses the dominant fisheries access share (47%).

The map (Figure 8) shows that license loss in the remaining LFAs (categorized by their respective counties) was greater than that of district 34; this dynamic resulted in an increase in the proportion of licenses held in LFA 34 (DFO, 2014b; Government of Nova Scotia, 2012). Unfortunately, the data and DFO do not specify whether the licenses were removed from the fisheries system. The literature review and primary data suggest that licenses were either retired (i.e. removed) or reissued during the various rationalization programs. The quantifications are only based on the number of active licenses, and do not include inactive or retired licenses.

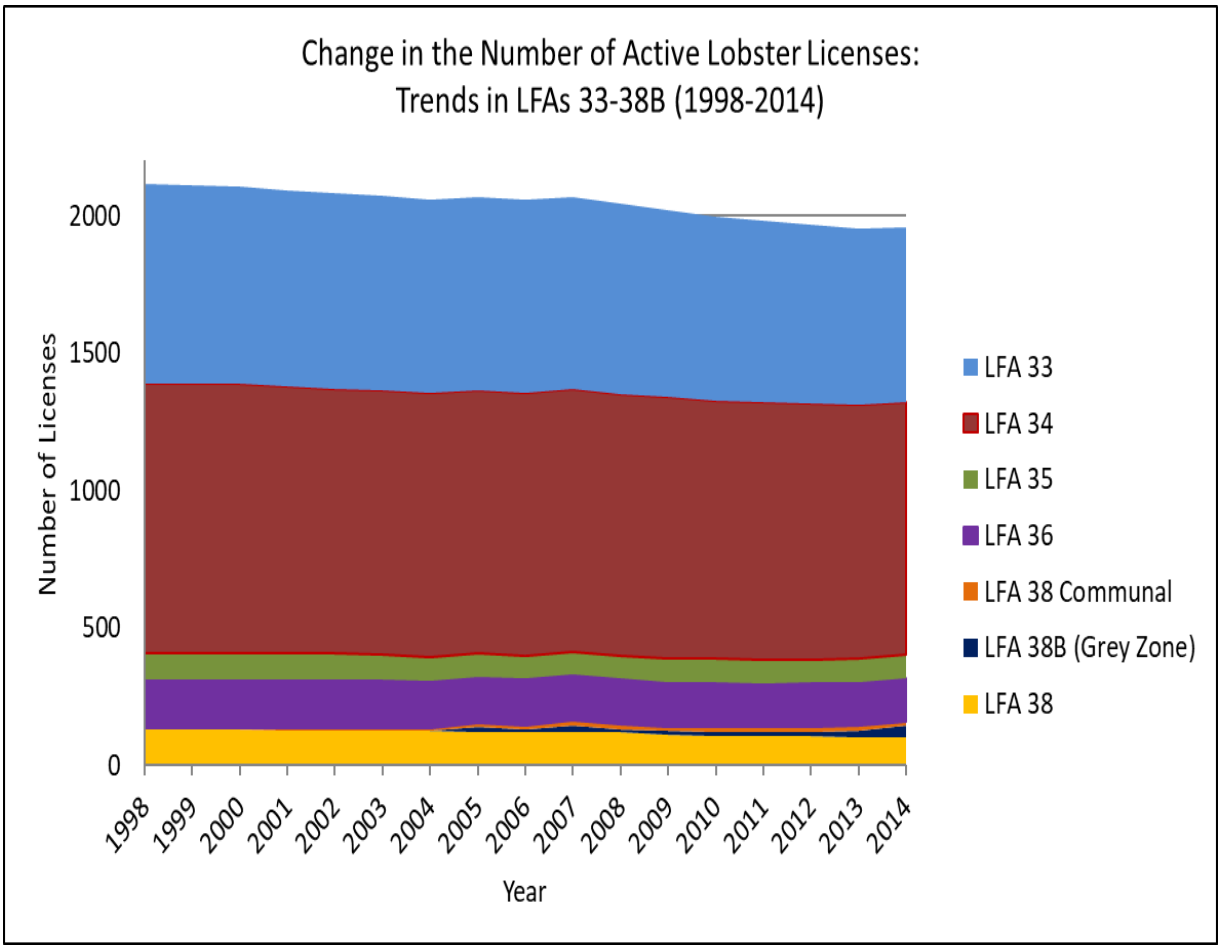


Figure 7. Linear trend of distributional change in access for the regional lobster fishery (1998-2014) (DFO, 2014b).

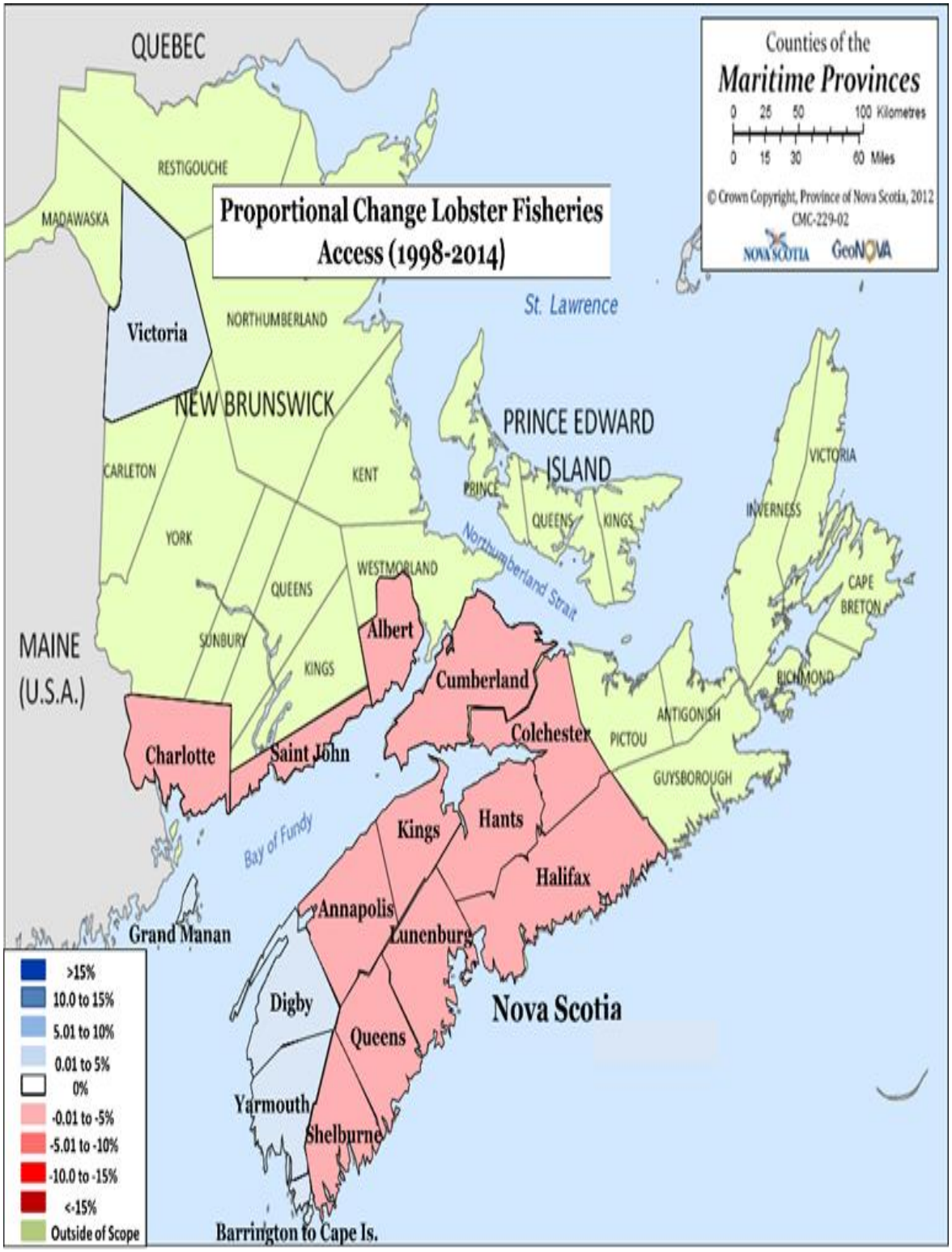


Figure 8. Change in the spatial distribution of regional lobster licenses (1998-2014) (DFO, 2014b; Government of Nova Scotia, 2012).

In figure 9, the Lorenz Curves show essentially no change in the regional distribution of lobster fishery access, from 1998 to 2014. Examining the Gini Coefficients, there is a slight increase in distributional unevenness (from 0.60 in 1998, to 0.58 in 2014) (DFO, 2014b). These results are likely due to the addition of Tobique First Nation to the fishery – where fisheries access is more evenly distributed to a greater number of communities.

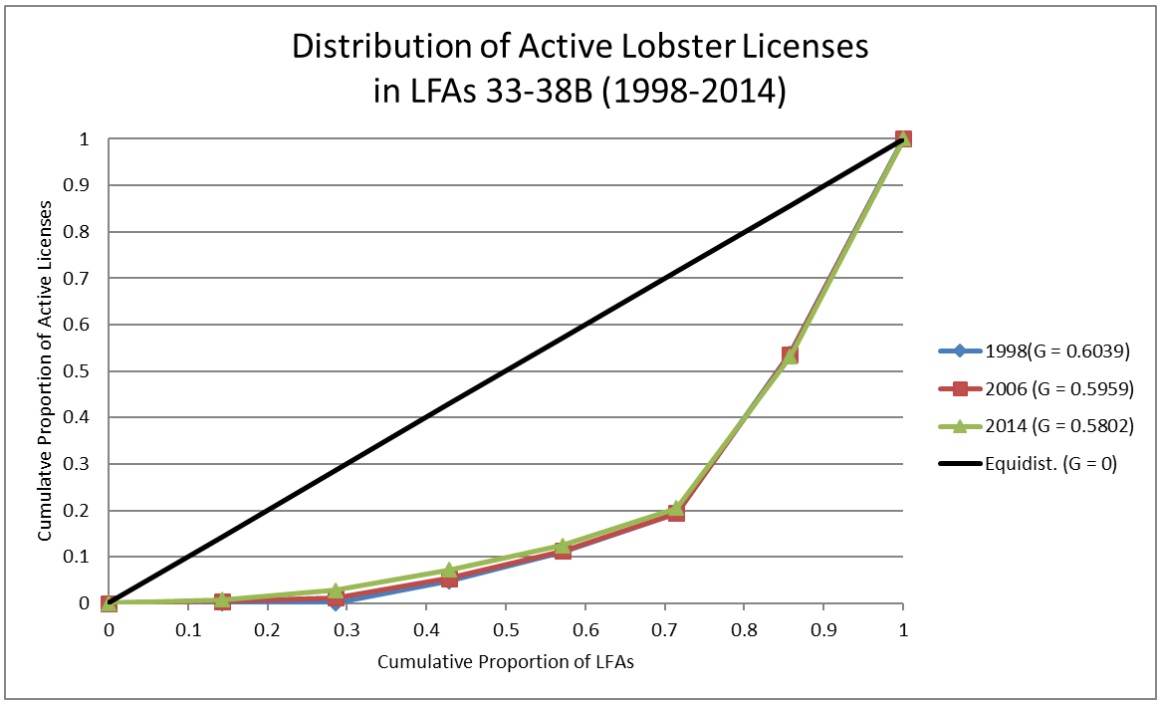


Figure 9. Lorenz Curves and Gini Coefficients depicting the absolute distributional change of regional lobster fishery access (1998-2014) (DFO, 2014b).

Regarding landed value, the interviewed lobster harvesters universally reported distributional change resulting from changes in ownership characteristics. Traditionally, lobster enterprises in Grand Manan were owned independently. Today, companies (e.g. one from Southwestern Nova Scotia) control some of the lobster enterprises in Grand Manan via trust agreements and other equity financing arrangements. Consequently, the community's traditional share of the lobster fishery's value has become diluted and

redistributed to companies and other communities. Second generation harvesters share less of the fishery's value than previous generations. Participant #23 argued,

> "I was absolutely alarmed when all of sudden, out of the blue (a SWNS firm bought a license from an LFA 38 harvester). You can't do that…it's a Grand Manan and White Head (Island) license, you just can't! Then all of a sudden it was allowed – it was never allowed…You never used to be able to sell a lobster license outside of Grand Manan until 2007…You see, if you go back and do you research, it was Romeo LeBlanc that was the federal minister of fisheries, and if you read the reason why he made up the lobster districts (LFAs) – it was so that the wealth from the ocean was equally distributed to the coastal communities on the Atlantic coastal of Canada."

Participant #34 explained the high costs of license and enterprise ownership creates barriers to second generation entry and is driving a greater number of these harvesters to seek equity financing. These dynamics shifted the distribution of landed value, along with the balance of power.

> "When the companies get into it (fishing industry) that's the end of it…If you took the companies out of it, right on Grand Manan, right now, and said no more companies can finance boats and keep these guys (second generation harvesters) going and pay their bills, 75% of (those harvesters) would close and go home."

When asked to elaborate whether companies financed 75% of the harvesters through trust agreements, participant #34 explained,

> "No, they're committed to the companies because they're in debt to their eyeballs to them. (The harvesters) planned on it. They look at us and shake their heads: how come we (referring to himself and other first generation/independent harvesters) don't do it (equity financing)? We buy what we can and do what we can. We don't have no fancy boats or nothing, but I can go wherever I want to and sell to whoever I want to, and they can't go anywhere. They're committed...to the buyer, and that's no way to operate." (Field Interview, 2014)

A common thread emerges in this case that shifting patterns of licenses, resulting from various owner/firm arrangements (e.g. partnerships, license 'stacking', trust

agreements, and equity financing), underpins the changing distribution trends in the other indicators. As the licenses left the island, or joined in partnerships, these dynamics prevented many captains, crews, and their vessels from accessing the fishery. Although it appears that employment and incomes may have increased for the Grand Manan fishery, there exists a paradox – the community has experienced an erosion of its independent fleet, which previously wholly benefited from this community sector. Furthermore, benefits increasingly shifted to Southwestern Nova Scotia and the New Brunswick aboriginal community.

When asked if any management strategies affected employment and total income in Grand Manan, participant #17 replied,

> "Not really, other than the native licenses. Native licenses have been bought from Grand Manan and leased to SWNS - so the people of Grand Manan have lost the benefits (referring to employment and income) of those licenses".

In contrast, the secondary data shows (Appendix F) that disparity decreased for regional distribution of adjusted landed lobster value, over time. Figure 10 shows that the value gap between the dominant LFA 34 and other LFAs (including Grand Manan) narrowed from 2005 to 2011. Similarly, figure 11 illustrates that the counties and communities which fish LFA 34 experienced a 14-percentage point drop in gross lobster revenue, while the other respective counties (which includes Grand Manan) saw gains (Government of Nova Scotia, 2012). In absolute terms of measuring these distribution patterns, the Lorenz Curves characteristically moved closer toward the equi-distribution line, indicating decreasing distributional variability (Figure 12). In numerical terms, the

Gini Coefficient also signifies decreasing distributional variability, moving from 0.61 in 1979, to 0.47 in 2011 (Bank of Canada, 2014; DFO, 2014).

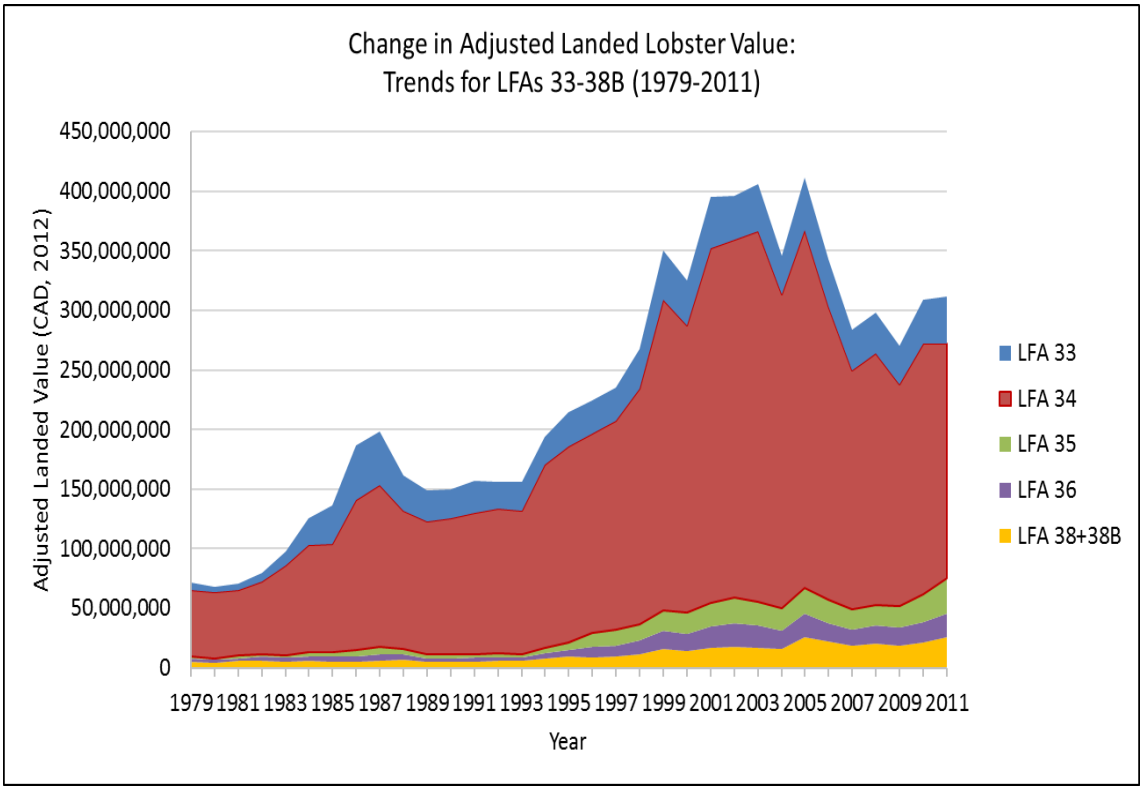


Figure 10. Trends displaying the distributional change of adjusted regional lobster value (1979-2011) (Bank of Canada, 2014; DFO, 2014c).

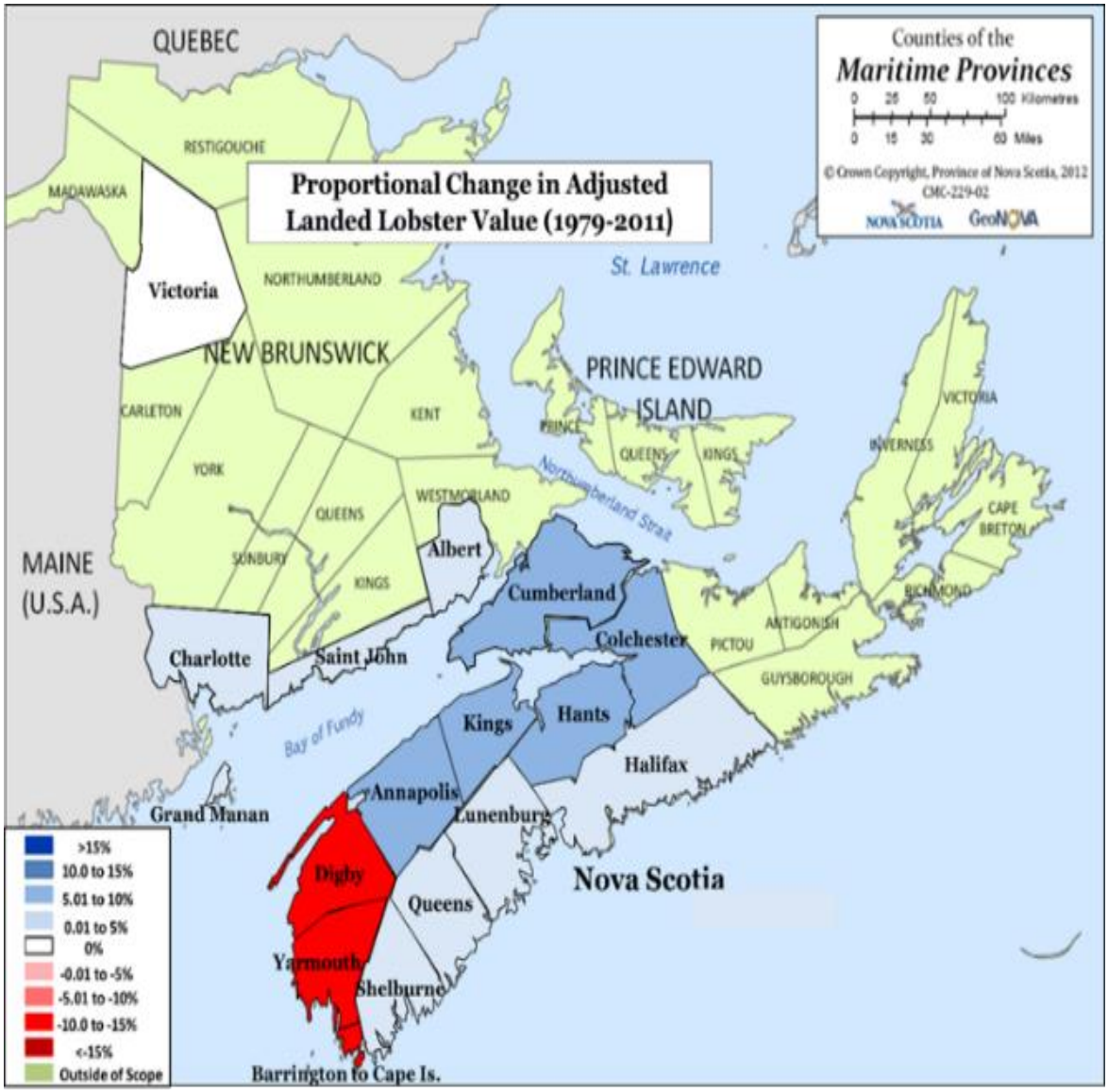


Figure 11. Spatial distributional change of adjusted regional lobster landed value (1979-2011) (Bank of Canada, 2014; DFO, 2014c; Government of Nova Scotia, 2012).

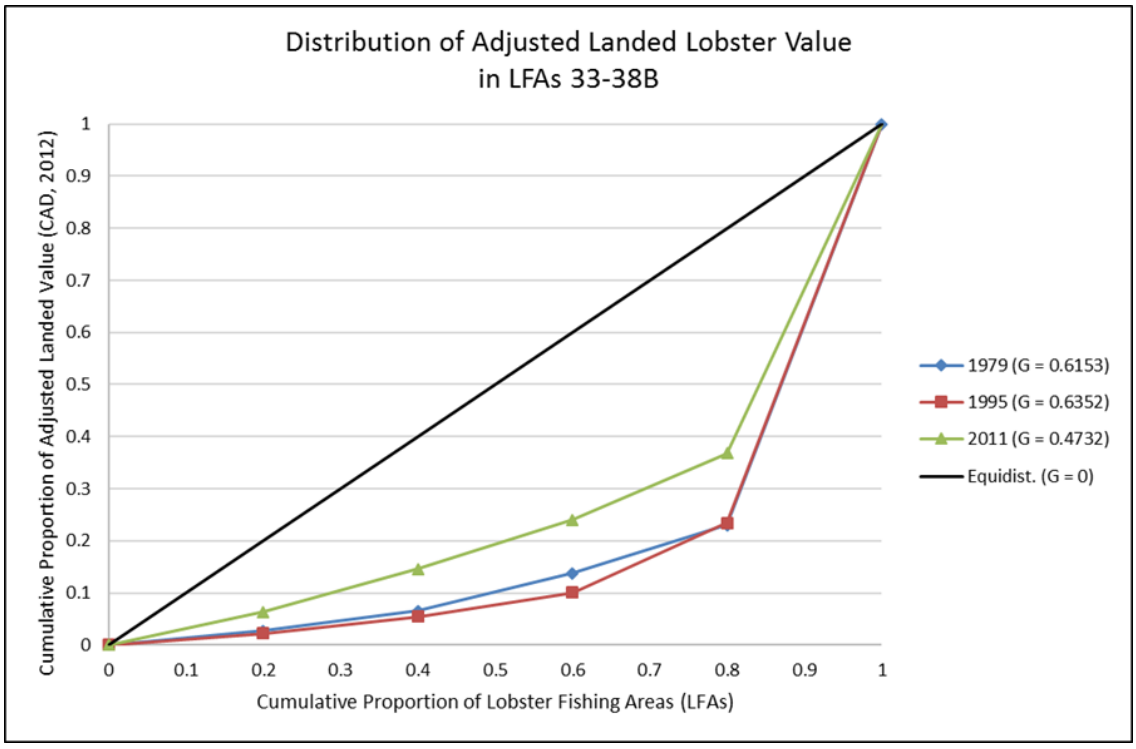


Figure 12. Lorenz Curves and Gini Coefficients for the regional distribution of adjusted lobster landed value (1979-2011) (Bank of Canada, 2014; DFO, 2014c).

The Herring Purse Seine Fishery

From the 1960s to 2014, the herring respondents explained that resource scarcity, open market trading, and financial instability contributed to narrowing the distribution of fishery benefits in Grand Manan and broadened regional disparity. Over time, a few companies in Southwestern New Brunswick (SWNB) and Southwestern Nova Scotia (SWNS) bought all the herring purse seine licenses and associated quota from Grand Manan enterprise owners. The herring seine fleet consolidated, and the suite of benefits derived from this fishery (revenue, income, and employment) increasingly became concentrated within a few communities in the broader region.

Participant #7 reported,

> "In 1950, there was probably 14 seiners on Grand Manan and possibly the same amount on Campobello… (Regarding the sale of his vessel) the quota stayed with the boat and it went to Nova Scotia… Now there's only 3 (seiners) that are fishing for (one New Brunswick company) …the reason that you're down to only 3 (seiners) is really because of the quotas".

The same participant described how the post-harvesting sector also consolidated regionally:

> "Well at one time the NB company used to have about 7 or 8 sardine plants. Now what do they have? They just have the one in Blacks Harbour. They (NB company) used to have one (sardine plant) here on Grand Manan, they had one in Weymouth, NS, they had one in Campobello, NB, they had one on Deer Island, NB, one in Back Bay, NB and one in Blacks Harbour, NB – and that was the big one."

Participant #5 concurs,

> "… (The) few large plant companies that are left (are) in SWNB and SWNS".

Participant #20 estimated the decreasing herring seine labour force:

> "Now, approximately only 20% of (the past labour force) are employed in this fishery"

The <65ft Mobile Groundfish Fishery

Analogous to the dynamics affecting distribution in the herring seine fishery, the traditional and independent mobile groundfish fleet consolidated over time under the ownership of a few Southwestern Nova Scotia firms with large market capitalization. The vessel rationalization expanded disparity, which triggered a movement of revenue, income, and employment out of Grand Manan toward Nova Scotia.

According to Participant #12,

> "…once the quota came in they all sold out to SWNS and now that area owns the works".

Participant #13 provided comments regarding the implications and contributing factors of the regional fleet concentration:

> "It's better to have 100 boats fishing and making a little bit of money than having 5-10 boats fishing the lion's share of the quota. It takes the livelihoods out of the communities…and concentrates it into one or two (communities)…all these jobs were lost to a few companies in SWNS…government policies have negatively affected the community by allowing outside companies to buy quota and licenses on Grand Manan".

Participant #9 reported that adjacency was a contributing dynamic in the shifting distributional variability of the regional mobile groundfish fishery:

> "The people that benefited the most (were) those that fished offshore – like those in Pubnico and SWNS – because they were closer (more adjacent) to a constant supply of fish. So, they bought out those that didn't have that (adjacency). This fleet wouldn't go down there because there would be an increased cost in fuel".

Participant #32 agrees,

> "Most people on Grand Manan fished the Northeast Bank, in the Bay of Fundy and down as far Brown's Bank. But the people in NS fished on George's Bank, Emerald Bank, Eastern Bank, Sambro Bank, Lehave Bank, etc. – which was right on their doorstep. From (Grand Manan) to George's (Bank) is a 22-hour steam (however, the area is closer to SWNS) … I made most of my living around NS"

Furthermore, Participant #35 reported,

> "…most of the fish were landed in NS and as they got a better price there…SWNS benefited as a lot of the catch was landed there".

Figure 13 (below) verifies the primary data and illustrates that distributional variability increased throughout the regional mobile groundfish fishery from 1998 to 2013 (Appendix G). Grand Manan lost 1 percentage point (i.e. 5 licenses); whereas, the

communities of Pubnico and Yarmouth (in Southwestern Nova Scotia) respectively gained 8 and 3 percentage points of the total fishery's access. Other communities (for which the data are aggregated into an unspecified category) also gained 4 percentage points of the license share. The remaining Nova Scotian communities experienced the greatest proportional access loss (-14 percentage points or -82 licenses), during the period (DFO, 2014b).

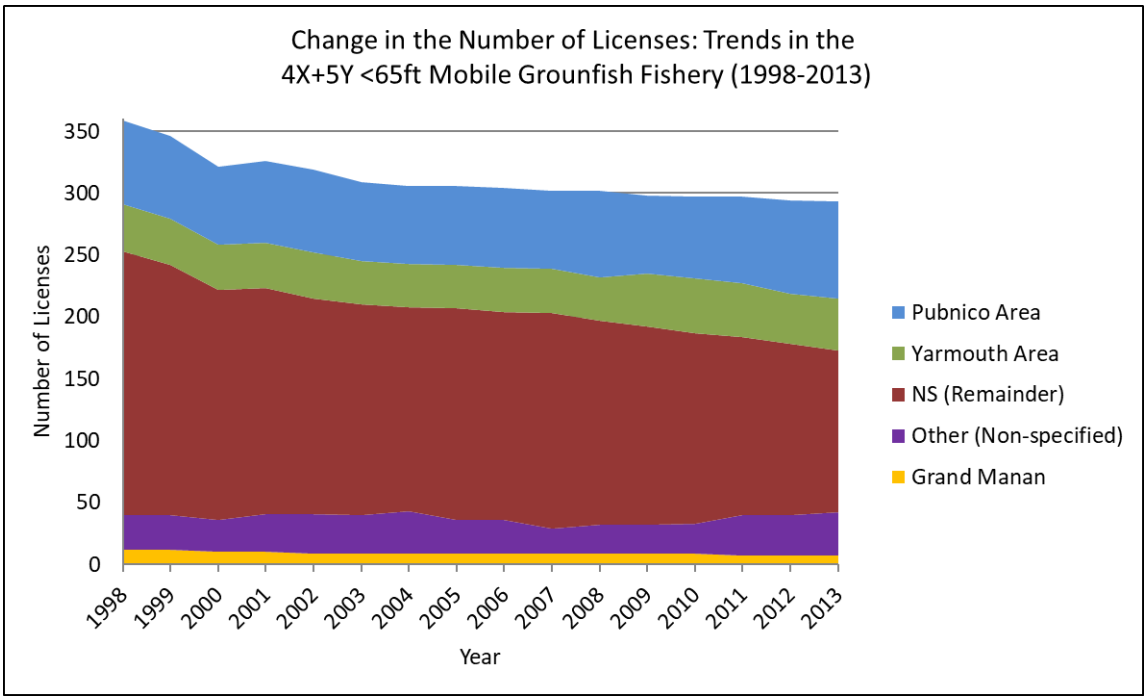


Figure 13. Change in the distribution of regional access trends for the mobile groundfish fishery (1998-2013) (DFO, 2014b).

Although Grand Manan maintains access to the mobile groundfish fishery, the analysis of the primary data reveals that these licenses are inactive and only a small group of the community's license holders benefit from revenue generated by leasing quota annually to SWNS firms. Participant #9 said, "Some still have mobile groundfish quota (as they still have their licenses) that's not fished (personally) but leased to companies".

According to Participant #33, "…there's 2-5 people that own quota and (lease) it out to NS every year". Participant #13 talked about the financial incentive of leasing quota, "I could make more money leasing quota than actually fishing" (Field Interviews, 2014).

Discussion

Changing Distribution of Community Fishing Benefits and Policy Analysis

Overall, the diversity of access to key fisheries in Grand Manan (i.e. lobster, herring seine, and mobile groundfish) has declined over time, leaving only lobster as an active fishery. This represents that the distribution of fishing benefits have narrowed in Grand Manan and the EAF policy objectives pertaining to equity and fairness have not been achieved in this context. Now, second generation Grand Manan harvesters do not have the same traditional, diverse multi-species fisheries access as previous generations. Consequently, the policy objective of intergenerational equity – described as a key concept of sustainable fisheries management by FAO (2009) – has not been achieved. The primary and secondary data showed that the number of fisheries available to Grand Manan fishers declined over time. It should be noted that the suite of 5 indicators (number of licenses, landed value, number of vessels, employment, and income) are related and potentially correlated.

This research presents evidence to inform policy-makers, and other interested parties, regarding the narrowing distribution of fishery benefits in Grand Manan and the poor

performance of the equity and fairness EAF policy objectives. Additionally, the primary data offers insights into the negative community effects of increasing disparity; namely, that the increasing disparity contributed to economic downturn and there is evidence that suggests the community is less resilient.

Diversity (i.e. heterogeneity), coupled with other social-ecological factors, is a key component to the resilience of social-ecological systems. Furthermore, resilience is the ability of the system to rebound from shocks, and maintain its integrity (Berkes & Ross, 2012; Marshall & Marshall, 2007; Charles et al., 2002). Diverse components of a system buffer against the shocks to help maintain the system's functionality (Hansen et al., 2015). In the past, Grand Manan's multi-species fisheries offered a range of diverse physical capital, access, value, employment, income, and traditional livelihoods (Marshall, 2009). These diverse aspects indicate that Grand Manan was once a resilient community - evident with the persistence of the lobster fishery, over the period. As Grand Manan suffered the shocks stemming from the downturn in the herring seine and mobile groundfish fisheries, the lobster fishery bolstered the community, at least in terms of landed value. Unfortunately, as time progressed, the revenue gains in the lobster fishery were unable to buffer against the knock-on effects of broad community downturn, and the losses in the herring and groundfish fisheries affected the local economy. Consequently, the community is now less diverse, less resilient, and more vulnerable to future disturbances.

All survey participants noted that transferability of licenses is one driver that has contributed to the increasing inequality throughout the fisheries. Over the past four decades, transferability has been the subject of a deeply divided discourse regarding its benefits and costs. Proponents argued that transferability: increases economic efficiency and profitability (by incentivizing less efficient operators to sell, or for more efficient operators to buy), is necessary for properly functioning markets, promotes a greater sense of ownership and environmental stewardship, and fleet consolidation/rationalization ensures conservation objectives are achieved (Barnett, 2014; Gough, 2007). In contrast, opponents contend transferability leads to a host of negative consequences – chief among them: consolidation of licenses to large companies and industrial fleets with wealth moving out of fishing communities, and a disproportionate number of well-financed firms and individuals benefiting in comparison to other small-scale, independent, and second-generation harvesters. Studies also indicate that the community stability resulting from non-transferability promotes a greater sense of ownership and environmental stewardship and helps conservation objectives to be achieved (Barnett, 2014; Haas, 2014; Gough, 2007; Edwards et al., 2006; Copes & Charles, 2004; McCay, 2004; McCay, 1996; Levelton, 1981). The results of this research align with the latter arguments and provide further evidence that the ease of fisheries license and/or quota transferability contributed to negative community outcomes – particularly, in Grand Manan.

The primary lobster data offers evidence of changing distribution of benefits throughout the region. At the regional scale, the fishery fails to meet the PIIFCAF policy objective – fishing benefits (i.e. access, value, vessels, employment, and income) have flowed away from the harvesters and community of Grand Manan.

The results also demonstrate that the other two key Grand Manan fisheries (herring and groundfish) had changes in the distribution of benefits that led to increased concentration of those benefits over time. Consequently, the suite of benefits (i.e. landed value, vessels, income, and employment) have been redistributed away from many coastal communities (including Grand Manan), resulting in increased intergenerational disparity. These community consequences and the EAF equity and fairness policy outcomes were left unmonitored for decades.

Overall, multiple reports from participants argued that open transferability contributed to the increasing regional inequality. Again, there are some proponents which support open market systems which benefit efficient enterprises and enables consolidation. However, this research shows that increasing regional inequality has had a greater negative impact on communities like Grand Manan, in comparison to the relative gains of the fortunate few.

There may also be broad policy implications regarding open transferability. This research supports the body of literature which advocates for policy alternatives that mitigate

against the negative community impacts of open transferability. The literature recommends policy alternatives which benefit those dependent on common-pool fisheries resources, through policies which are community-focused, involve full industry, government, and academic collaboration, and are supported by integrating multiple sources of knowledge (Barnett, 2014; CFRN, 2013; FAO, 2009; Ostrom, 2009; Edwards et al., 2006; Copes & Charles, 2004; McCay, 2004). Based on the results of this thesis, I recommend further exploring these policy alternatives.

Data: Strengths and limitations

Triangulating (i.e. cross-referencing) quantitative and qualitative data produced strong evidence of increasing disparity. The data revealed that disparity continued to grow in the herring and groundfish fisheries at the community and regional scales. Consequently, these approaches satisfy the utility requirements prescribed by the literature – where multiple data sources provide robust monitoring and increase the scientific validity of the research (Barnett, 2014; Edwards, 2008; Gerring, 2007; Boyd & Charles, 2006; Rice & Rochet, 2005; Garcia, Staples, & Chesson, 2000).

Moreover, triangulating primary data not only indicates increasing community and regional inequality for the herring and groundfish fisheries, but also provides perspectives into the microeconomic, ecological, and institutional drivers which have reinforced this inequality. Coulter (1989) highlighted that understanding the causes of inequality are critical to efforts which measure this phenomenon, and other efforts which aim to reduce it. Policy-makers, concerned with balancing multiple management

objectives of conservation, economic prosperity, equity, and the trade-offs of these decisions, can use this case study (and similar research) to form a suitable basis for assessing distributional impacts.

Unfortunately, a narrow scope of data collection, and a privacy policy which restricted access to data, constrained the availability of secondary data. Consequently, I was unable to cross-reference the primary data gathered for the number of vessels, employment, and income indicators, with secondary data, which limited the level of validation. Nevertheless, the primary data for the latter indicators also signified increasing community and regional disparity for the herring and groundfish fisheries. Reflecting on the social-ecological systems (SESs) theory, these results are logical since there are cross-scale linkages in these systems. Thus, changes in one scale of a fisheries system ultimately impact another scale as they are interdependent (Berkes et al., 2014; Barnett, 2014; FAO, 2009; Ostrom, 2009; Lui et al., 2007; Wilson, 2006; Hughes et al. 2005; Berkes, Folke & Colding, 1998).

Another anomaly emerged – the regional secondary data on lobster licenses and revenue diverged from the primary data and indicated distributional variability decreased for these metrics. This divergence occurs due to the collection and aggregation of each type of data. I solely sourced the primary data from Grand Manan harvesters (local scale) who offered their knowledge of the micro-economy. In other words, their viewpoints represent their insights into the interactions between individuals and firms, in Grand Manan, as well as in general terms of the region.

Additionally, the participants argued that the revenues generated from several LFA 38 licenses are being disproportionately distributed to SWNS (i.e. communities adjacent to LFA 34). This seemingly subtle nuance can have stark consequences for the local economy – as described by the participants. This distinction further alludes to the deficiencies within public data sets; particularly, current secondary data collection methods are unable to accurately monitor absolute community distribution patterns.

Under further examination, the regional lobster secondary data reveals that on a broad regional scale, and not considering the possibility of controlling agreements over lobster licenses, the distributional change of access was stable even though the total number of licenses declined, over time. The data depicts a dynamic where fewer licenses have become more broadly distributed to an increasing number of stakeholders (namely, increased access to LFA 38B, and increased aboriginal communal access to LFA 38). With respect to lobster revenues, the secondary data depicts that landed value become more widely distributed even considering a large decline in LFA 34. The increased access to LFA 38B and to the aboriginal community is also contributing to this dynamic – lobster value is now more evenly spread to a greater number of social components, than in previous years.

The regional lobster secondary data also sheds light on the distribution of benefits to a First Nation community. The Tobique First Nation in New Brunswick increased their community's access to the fishery through DFO's Allocation Transfer Program (ATP)

(Sonnenberg, M., personal communication, Sept. 26, 2013). However, the landed value data depicts no increase in the community's revenue. This anomaly may be due to how the data are aggregated. Since DFO aggregates the data by the communities where lobster is landed, and since the Tobique community is land-locked, the data do not reflect the true value gained by the community nor its fishery participants. Also, the primary data reveals that many Tobique licenses are leased and as a result, presumably some of the benefits from the fishery are flowing to communities in Southwestern Nova Scotia. Further research is needed to examine the full extent of how this community, its harvesters, and others across the region are benefiting from the fisheries.

Since it was not feasible to conduct a broad regional survey, the current primary dataset does not fully represent macroeconomic trends – it only provides participants insights into these trends. DFO aggregated the secondary data at the regional scale, which depicts trends across the macro-economy – distribution of access and value amongst the regional counties. However, since the secondary data do not incorporate microeconomic data within the aggregation (e.g. the distribution of access and value across the number of license holders or firms throughout the region), the analysis likely obscures the actual regional distribution trends. Therefore, to strengthen the knowledge base to depict these trends more accurately will require further investigation of both types of lobster data (Paterson & Kainge, 2014).

Chapter 4: Conclusions

In the wake of the failure of conventional fisheries management, there has been a decades-long global movement which strives for a paradigm shift (FAO, 2009). Since fisheries are inherently complex social-ecological systems (SESs), they require a management regime which holistically and adaptively responds to the many wicked problems which challenge the integrity of these systems. Pundits propose that the ecosystem approach to fisheries (EAF) paradigm has the broad proactive capabilities that are required to affect positive change in global fisheries.

Proponents acclaim that the EAF is particularly attuned to the demands of fisheries SESs, by addressing compounding societal and ecological challenges. The EAF is designed to account for the shortcomings of conventional fisheries management, by also considering distribution and impacts to coastal communities (to name a few fisheries aspects). As the EAF has evolved globally, policies and respective frameworks have emerged to reflect the EAF constitutions. In the Canadian context, the Canadian Fisheries Research Network (CFRN) has developed the Comprehensive Fisheries Sustainability Framework in collaboration with academics, industry stakeholders, and government officials in response to the global EAF movement. The CFRN framework provides a holistic set of outcome-based indicators and corresponding attribute metrics which examine the following four pillars of sustainability, relative to underlying policy objectives: ecological, social/cultural, economic, and institutional.

The goal of this research was to assess the outcomes of EAF equity and fairness policies which pertain to objectives of the distribution of access, community benefits, and intergenerational equity. I develop and test a suite of indicators, which are capable of evaluating the EAF equity and fairness policy objectives (in chapter 1).

These objectives prescribe that net benefits from fisheries shall be equitably distributed across generations of harvesters and their communities. Furthermore, not only does this thesis respond to the research requirements for testing the CFRN framework and the shortcomings of global policy frameworks, but it is also an academic response to an industry-driven research objective. Explicitly, this research acknowledges the reports from the independent harvesting sector regarding increasing distributional variability in the community fisheries of Grand Manan, NB. Moreover, I explore the changing distribution of net benefits within three of the community's fisheries (lobster, herring seine, and mobile groundfish) and the challenges they are purported to be facing.

Throughout the thesis, I contemplated the following thesis questions: to what extent has the distribution of net benefits changed within these Grand Manan fisheries? What knowledge sources can be gathered on this subject? Is collaboration useful? In chapter 2, using a systematic selection methodology, I aggregated social and economic candidate indicators from the literature and screened them against a series of utility criteria. I used the criteria to analyze the indicators' utility of evaluating the case fisheries in the various contexts of the policy and industry objectives: community, the three fisheries sectors, net benefits, distribution, and data availability.

This analysis produced a suite of 5 applicable indicators (number of licenses, number of vessels, employment, landed value, and income) out of a total of 42 global social and economic indicators. A narrow institutional data collection regime and the thesis scope constrained the utility of global indicators at the community scale. Albeit, the goal should not be to amass and analyze the largest set of indicators. On the contrary, the literature argues that this practice should be avoided and that an appropriate minimum dataset can offer decision makers and industry groups with an understandable appreciation of the fishery (FAO, 2009; Rice & Rochet, 2005).

In chapter three, I applied the suite of benefits indicators to the three case fisheries in Grand Manan using quantitative and qualitative techniques. Secondary data, which was only available to account for the number of licenses and landed value, revealed that the local economy became less diversified. Out of the three fisheries assessed, only the lobster fishery remains. The primary data corroborated the latter findings and exposed a deeper narrative. Fisheries access loss and the outward sale of physical assets (e.g. vessels) contributed to increasing unemployment and income disparity. This local economic downturn and the homogeneity of the social and economic fabric have destabilized the community's resilience and increased its vulnerability. Furthermore, license transferability policies enabled these community outcomes, which have also perpetuated throughout the region. In short, the EAF equity and fairness policy objectives I analyzed are not achieved. Additionally, I categorize this system as

unsustainable – the Bruntland (1987) definition is not met and the needs of future generations have been compromised.

At face value, this thesis discovered the shortcomings and unintended consequences of public fisheries policies. Furthermore, this research exposes the underpinnings which have doomed the EAF equity and fairness policies from their inception. Chiefly, the EAF equity and fairness policies lack a clear framework to guide managers. There is no context for equity – it is hollow to write policies which strive to achieve equity, when there is no context of what equity is, how to measure it, and what tools are needed for its proper assessment. Moreover, the EAF equity and fairness policies have suffered from emphatically slow political processes. Owner-operator and fleet separation policies are still not enshrined into legislation, and it has been over 40 years since they werefirst introduced as policy statements by Fisheries Minister at the time Romeo LeBlanc. Furthermore, there exist conflicting management objectives within the EAF framework where equity and fairness policies are often overshadowed by ecological policy goals of resource conservation.

The CFRN's principal objective was to provide Canada, and the world, with a robust framework required for the EAF – in order to holistically manage fisheries for the future. The framework also includes indicators and attributes which explore distribution and equity. However, the CFRN did not define reference points needed to assess equity. Consequently, I used current tools to evaluate whether the EAF equity and fairness

policy objectives were achieved based on the changing status of distributional variability, given the narrow breadth of data and lack of appropriate equity measures.

To the extent that equity is a significant objective, future analyses will need to further contemplate and define equity standards and the level of tolerable distributional variability. These standards will function as reference points for each indicator – thresholds which delineate between the achievement or failure of the policy objectives. Future assessments will also require expanding current public and private datasets, improving access to public information, and broadening scopes to support the policies. Moreover, I echo the literature and call for full participation of all concerned stakeholders – there is clear evidence that deep collaboration fosters positive outcomes for these initiatives. Lastly, in order to execute future fisheries policy on the road to the EAF and sustainability, there is a lot at stake - not only does the success of public policy hang in the balance, but more importantly, the future prosperity and resilience of coastal fishing communities.

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Appendix A: CFRN Evaluation Framework for Sustainable Fisheries

Table 1. Evaluation Framework for Sustainable Fisheries, Version 2.1: Example Indicators and Attributes (Angel et al., 2014)

DOMAIN: Ecological

DIMENSION	ELEMENT	INDICATOR
Productivity	**Ecological Productivity:** Fluctuations of species and population abundance.	• [Recruitment Dynamics][6] description for [Resource Demographic Category][2] within a [Resource Geographic Region][3] • [Quantification][12] of Fishing Mortality. • [Quantification][12] of Escapement and determine relationship to [Recruitment Dynamics][6].
	Geographic Range: Fluctuations of species and population geographic range	• [Index of Abundance][4] in a [Resource Geographic Region][3] during a [Time Period][5] • [Status][1] of [Resource Demographic Category][2] within a [Resource Geographic Region][3]
	Phenotypic & Genetic Diversity: Fluctuation of species and population phenotypic and genetic diversity	• [Genetic Diversity][7] and [Phenotypic Diversity][8] among a [Resource Demographic Category][2] within a [Resource Geographic Region][3] • Change in [Genetic Diversity][7] and [Phenotypic Diversity][8] among a [Resource Demographic Category][2] over [Time Period][5]
Habitat	**Substrate Quality:** Changes to benthic geology and geomorphology	• Proportion of habitat types impacted, and the degree of impact, by [Anthropogenic Activity][10] • Proportion of sensitive [Benthic Species][11] subject to [Anthropogenic Activity][10] • Proportion of fishing grounds surveyed and mapped • Habitat Maps considering presence/absence and abundance of [Benthic Species][11] • [Quantification][12] of [Gear][13] loss • [Quantification][12] of [Gear][13] modifications applied in a [Fishery Category][14] designed to reduce impact to substrate quality • Accounting of [Gear][13]
	Water Quality: Changes to water quality	• [Quantification][12] of [Pollution][15] in a [Resource Geographic Region][3] • [Quantification][12] of Anoxic zones in a [Resource Geographic Region][3] • [Eutrophication evidence][19] in a [Resource Geographic Region][3] • Risk assessments for major catastrophic

		[Pollution][15] events • [Quantification][12] of [Pollution][15] within [Fishery Category][14] over [Time Period][5]
Biodiversity	**Food-web Persistence:** Persistence of structure and natural resilience of the ecosystem	• [Food-web Interactions][16], including [Anthropogenic Activity][10], that enhance/maintain [Food-web Stability][17] • [Quantification][12] of incidental/bycatch mortality by [Fishery Category][14] • [Quantification][12] of [Gear][13] modifications applied in a [Fishery Category][14] designed to reduce incidental mortality • [Biodiversity Indices][9] in a [Resource Geographic Region][3] • Change in [Biodiversity Indices][9] over [Time Period][5]
	Non-Native Species: Extent and impact of non-native species	• Degree of impact of introduced species on [Food-web Stability][17] • Probability of introduction of new species to ecosystem • [Quantification][12] of introduced species in ecosystem • Probability of ability to extirpate introduced species, proportional to the degree of impact to [Food-web Stability][17] • [Quantification][12] of extirpation of introduced species, proportional to the degree of impact to [Food-web Stability][17] • [Quantification][12] of aquaculture escapes. • [Quantification][12] of introduction and proliferation of disease/pathogens.
	Regime Shifts: Risks to ecosystem stability due to changes in climate	• [Regime Shift Indicators][18] • [Quantification][12] of Green House Gas emissions • Fuel efficiency of fishing operations in a [Fishery Category][14] • Risk of Regime Shift or fisheries collapse

DOMAIN: Social and Economic

DIMENSION	ELEMENT	INDICATOR
Health and well-being	**Basic needs:** Fulfillment of basic human needs	• [Social Factor][20] among [Human Population][21] in [Human Geographic Region][22] • Proportion of [Human Population][21] in [Human Geographic Region][22] below the poverty line • Income disparity in [Human Geographic Region][22] (e.g., Gini coefficient, ratio of highest wage to average wage) • Availability of affordable [Services][23] to [Human Population][21] in [Human Geographic Region][22] • Ratio of [Services][23] cost to gross adjusted disposable income of the household • Ranking of the quality of [Education][24] at [Human Geographic Region][22] level
	Food security: Contribution to food security	• [Quantification][12] of [Seafood][25] caught [Adjacent][26] to [Human Geographic Region][22] by [Product Category][27]
	Food safety: Quality and safety of food along the supply chain	• [Quantification][12] of fish and seafood establishments regulated for food safety • [Quantification][12]of fish and seafood regulated establishments inspected within the past 5 years • [Quantification][12] of inspected fish and seafood regulated establishments in compliance with applicable regulations • [Quantification][12] of reported cases of food-borne illness from [Seafood][25] • Landed value of [Seafood][25] • Price per lb of [Seafood][25] • [Quantification][12] of [Seafood][25] by [Processing Type][28]
	Occupational safety: Workplace health and safety conditions	• [Quantification][12] of deaths at-sea • [Quantification][12]of injuries in [Fishery Category][14] per [Time Period][5] • Ranking of job safety • Proportion of fisheries work force subject to Canadian labour laws • Proportion of fisheries workforce that meets [Certification Standards][29]
	Informed citizenry: Public understanding and recognition of fisheries	• Rating of importance of fisheries in opinion polls in [Human Geographic Region][22] among [Human Population][21] • Stated preference valuation for the existence of

		fisheries dependent communities in [Human Geographic Region][22] • Willingness to pay for [Seafood][25] caught [Adjacent][26] to [Human Geographic Region][22] • [Quantification][12] of [Data][30] readily accessible to the public • Number of visits to [Fishery Related Website][31] • The [Organization Condition][32] of community events highlighting value of seafood and fisheries
	Vital civic culture: Participation and engagement in public life	• The [Organization Condition][32] of [Organization][33] in a [Human Geographic Region][22] • Voter turnout in a [Human Geographic Region][22] for [Jurisdiction][34] election among [Human Population][21]
	Well-being: Quality of life	• [Qualitative][35] evidence of subjective perception of well-being, applied at [Human Geographic Region][22] • [Well-being Index][36] applied at [Human Geographic Region][22]**Error! Reference source not found.**
Equity and Fairness	**Allocation:** Fairness in the allocation of resource benefits	• [Quantification][12] of reallocations of [Resource Demographic Category][2] across [Stakeholder Group][38] rights without [Compensation][39] • Proportion of realized [Compensation][39] relative to fair market value of reallocated [Resource Demographic Category][2] across [Stakeholder Group][38] rights • Proportion of realized allocation relative to potential allowed allocation • Loss of income from reallocation of access rights by [Economic Unit][37] in [Human Geographic Region][22] • [Quantification][12] of [Seafood][25] harvest across [Fishery Category][14] being contested by one or more [Stakeholder Group][38]
	Stability: Stability of access to resource benefits	• Distribution of catch by [Sector][40]**Error! Reference source not found.**, [Human Geographic Region][22], [Economic Unit][37] • Distribution of [Access][41] by [Human Geographic Region][22], [Human Population][21], [Sector][40], [Operator Type][42] • [Quantification][12] of major changes to [Access][41] conditions over [Time Period][5] • [Quantification][12] of [Fisheries Related Private Infrastructure][43] by [Fishery Category][14] and

		[Human Geographic Region][22]
	Costs & Benefits: Equitable distribution of benefits and costs	• Value of fisheries related [Fisheries Related Public Infrastructure][44]in [Human Geographic Region][22] • Value of fisheries related [Fisheries Related Private Infrastructure][43] in [Human Geographic Region][22] • [Benefit Axis][45] by [Socio-economic distribution axis][46] • [Cost Axis][47] by [Socio-economic distribution axis][46] • Distribution of [Value Type][48] by [Value Chain Element][49] • Distribution of [Value Type][48] by [Operator Type][42]
	Risks & Rewards: Equitable distribution of risks and rewards	• [Risk Axis][50] by [Socio-economic Distribution Axis][46]
	Livelihoods: Sustainability of livelihoods	• [Livelihood Index][51] applied at [Human Geographic Region][22] • Unemployment rate in fishery-dependent [Human Geographic Region][22]
Economic and financial	**Human capital:** Development and maintenance of human capital	• [Human Demographic Axis][52] by [Occupational Axis][53] • [Quantification][12] of [Time Period][5] in the industry by [Occupational Axis][53] • [Quantification][12] of generations of fishing history of current participants in the fishery • [Quantification][12] of fishermen meeting [Certification Standards][29]
	Efficiency: Maximization of harvest value relative to waste	• Realized catch relative to potential target harvest • [Quantification][12] of [Resource Demographic Category][2] discard waste • Market price relative to private marginal cost of production • Cost of output for [Economic Unit][37] by [Fishery Category][14] relative to the lowest possible average total cost • Output obtained from a given quantity of inputs relative to the maximum output obtainable from that given quantity of inputs • [Productivity][54] of [Economic Unit][37] by [Fishery Category][14] • [Efficiency][55] of [Economic Unit][37] by [Fishery

		Category][14]
	Financial viability: Financial viability of fisheries enterprises	• Net profit of enterprises in [Fishery Category][14] and by [Gear][13] • Bankruptcy rate for participants in [Fishery Category][14] and by [Gear][13] • Investment stock/flow in fishery, by [Fishery Category][14], [Operator Type][42] and [Gear][13] • Availability of capital/debt financing by [Fishery Category][14], [Operator Type][42] and [Gear][13] • [Financial ratio][56] by [Fishery Category][14], [Operator Type][42] and [Gear][13] • [Quantification][12] of enterprises dependent on one fishery • Number of fisheries that fishing enterprises participate in • Proportion of investment stock/flow in depreciating assets versus access [Agreement][57] by [Operator Type][42]**Error! Reference source not found.**
	Labour: Sustainability of the labour force	• [Experience][58] and [Education][24] by [Occupational Axis][53], [Fishery Category][14] and [Gear][13] • Availability of [Occupational Axis][53] with the required [Experience][58] [Education][24] and [Certification Standards][29] • Distribution and mean of [Compensation][39] by [Occupational Axis][53] [Fishery Category][14], [Gear][13] and [Human Geographic Region][22] • Unemployment rate in the [Human Geographic Region][22] • Proportion of [Fishery Category][14] and [Gear][13] subject to [Agreement][57] • Proportion of [Occupational Axis] labour force represented by an industry [Organization] • [Quantification][12] of [Labour Tactic][59] • [Human Demographic Axis][52] by [Occupational Axis][53]
	Markets: Health and functioning of markets for goods, services and capital	• Availability of [Financial Information][60]to [Value Chain Element][49] • Presence/absence of oligopsony or monopsony in [Value Chain Element][49] • % control of each stage of the value chain by single entity and by [Value Chain Element][49] through [Agreement][57] • Presence/absence of [Legislation/Regulation][61] to restrict [Market Failure][62] • [Enforcement][63]of restrictions on [Market

		Failure][62]
	Economic sustainability: Sustainability of profits at all stages of the value chain	• Economic sustainability index • [Financial Information][60] trends • Value of [Economic Variables][64] by [Fishery Category][14]

DOMAIN: Institutional

DIMENSION	ELEMENT	INDICATOR
Structure	**Rules:** Legal, regulatory and policy framework is appropriate	• Proportion of [Anthropogenic Activity][10] covered by [Institutional Arrangement][65] and subject to [Legislation/Regulation][61] and/or [Management Plan][66] • [Qualitative][35] evidence of support for the [Institutional Arrangement][65] and/or [Legislation/Regulation][61] and/or [Management Plan][66] amongst [Stakeholder Group][38] • [Qualitative][35] evidence of consistency between the [Institutional Arrangement][65] and [Legislation/Regulation][61] and [Human Population][21] norms and values • [Qualitative][35] evidence of consistency in [Institutional Arrangement][65]between [Stakeholder Group][38]
	Resources: Funding and other support is adequate and reliable	• Level and duration of [Support][67] for [General Management Activity][68] and/or [Fisheries Management Activity][69] amongst [Stakeholder Group][38] and/or [Human population][21] at [Human Geographic Region][22] • Types of [Conflict Resolution Approaches][70] available to deal with disputes
	Agreements: Agreements between participants are comprehensive and enforceable	• [Quantification][12] of agreements involving [Stakeholder Group][38] and/or [Human Population][21] containing [Agreement Element][71] • [Quantification][12] of agreements involving [Stakeholder Group][38] and/or [Human Population][21] supported by [Institutional Arrangement][65] and/or [Legislation/Regulation][61]
Process	**Collaborative:** Collaborative	• [Qualitative][35] evidence of [Stakeholder

	relationships within and between governments and other parties	Group][38] and [Human Population][21] perception of collaboration by [Collaboration Type][72] • Degree to which [Collaboration Criteria][73] exist • [Quantification][12] of [Collaboration Criteria][73] • [Quantification][12] of [Stakeholder Group][38] participation in [General Management Activity][68] and/or [Fisheries Management Activity][69]
	Co-operation: Best efforts are made to address conflicts between stakeholders	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of co-operation • Degree to which [Co-operation Criteria][74] exist • [Quantification][12] of [Co-operation Criteria][74]
	Inclusive: Inclusive processes that support participation	• [Qualitative][35] evidence of [Stakeholder Group][38] [Human Population][21] perception of inclusivity • Degree to which [Inclusivity Criteria][75] exist • [Quantification][12] of [Inclusivity Criteria][75] • [Quantification][12] of [Stakeholder Group][38] participation in [General Management Activity][68] and/or [Fisheries Management Activity][69]
	Informed: Stakeholders have access to best available information and analysis	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of how well-informed participants are • Degree to which [Information Standards][76] exist • [Quantification][12] of [Information Standards][76]
	Predictable: Predictable and consistent decision-making procedures that are not changed without adequate consultation or justification	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of [Predictability Criteria][77] • Documentation of [Access][41] • Documentation and[Quantification][12] of changes to [Access][41] • Existence of [Management Plan][66] • Documentation and [Quantification][12] of changes to [Management Plan][66]
	Flexible: Flexible and responsive processes that can be adapted to changing circumstances	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of flexibility

		• Degree to which there is [Flexibility Criteria][78]
	Transparent: Open and transparent policies, procedures, decisions, and supporting documentation	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of transparency • Degree to which there is [Transparency Criteria][79] [Quantification][12] of [Transparency Criteria][79]
Outcomes	**Compliance:** Regular evaluation of and reporting on compliance with legal, regulatory and policy framework	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of compliance • Degree to which there is [Compliance Criteria][80] • [Quantification][12] of [Compliance Criteria][80]
	Power dynamics: Explicit consideration of power dynamics in decision-making	• [Qualitative][35]evidence of [Stakeholder Group][38] and [Human Population][21] perception of power dynamics • Degree to which [Power Dynamics Criteria][81] are identified and addressed
	Appropriateness: Explicit consideration of constitutional, collective, and operational levels in decision-making	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of appropriateness • Presence/absence of role for [Stakeholder Group][38] in the development, establishment and enforcement of rules at the [Rule Level][82] • Degree to which [Accredited Organization Criteria][83] was consulted in the development, establishment and enforcement of rules at the [Rule Level][82] • Degree to which [Stakeholder Group][38] role in the development, establishment and enforcement of rules at the [Rule Level][82] is commensurate with impact of rule on the [Stakeholder Group][38] • Degree to which there is [Flexibility Criteria][78]
	Trade-offs: Explicit consideration of trade-offs in decision-making	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21] perception of trade-off • Degree to which [Trade-off Criteria][84] are identified and implemented • [Quantification][12] of [Trade-off Criteria][84]
	Assessment: Regular evaluation of and reporting on outcomes in	• [Qualitative][35] evidence of [Stakeholder Group][38] and [Human Population][21]

	the ecological, community, and institutional dimensions of the fishery	perception of assessment • [Quantification][12] of [Fishery Category][14] subject to assessment • Degree to which [Assessment Method][85] exists • [Quantification][12] of recommendations from evaluation addressed in subsequent management activities

ATTRIBUTES

1. **Status:** B_t/B_{target}; B_t/B_{lim}; B_t/B_0; Probability of Extinction; COSEWIC/SARA designated unit status
2. **Resource Demographic Category:** species; population; stock; size; sex; age class
3. **Resource Geographic Region:** province; country; Exclusive Economic Zone; region; management area; marine area; river system; lake; watershed
4. **Index of Abundance:** CPUE; WPUE; survey estimates; stock assessment biomass/abundance estimates
5. **Time Period:** day; week, month; season; year; decade; century
6. **Recruitment Dynamics:** compensation or depensation; changes in average recruitment
7. **Genetic Diversity:** genetic variation using microsatellites and mitochondrial DNA; genetic mixing; genetic sex ratio
8. **Phenotypic Diversity:** phenotypic variation in measurable characteristics; maturation-at-age; size-at-age; phenotypic sex ratio
9. **Biodiversity Indices:** species richness; Shannon's diversity; species assemblage structure
10. **Anthropogenic Activity:** harvesting; shipping; tourism and recreation; oil and gas extraction/processing; mining; forestry; aquaculture; construction; residential development
11. **Benthic Species:** corals; sponge; crystalline algae
12. **Quantification:** proportion; number; frequency; total area; total volume; presence/absence; ratio
13. **Gear:** nets; traps; hooks; longline; trawl; troll; gillnet; seine; trap; hook and line; dive
14. **Fishery Category:** fishery (by species, gear, market); fleet (by vessel size, ownership, gear)
15. **Pollution:** thermal & heated water; sewage; debris; oil discharge; noise; light
16. **Food-web Interactions:** Interaction Strength; Metabolic Respiration; energy flow; carbon flow
17. **Food-web Stability:** CV of biomass; Eigenvalue from Community Matrix Interactions.
18. **Regime Shift Indicators**: CV of biomass; Average Trophic Level; Length of fish; End-to-End Ecosystem Models; Ecosystem Exploitation Index
19. **Eutrophication evidence**: nutrient concentrations; hypoxia; algal blooms; changes phytoplankton communities; fish kills.
20. **Social Factor:** suicide rate; infant mortality rate; unemployment rate; migration rate; employment rate; life expectancy; real per capita income; job satisfaction level employment rate; life expectancy; real per capita income; job satisfaction level
21. **Human Population:** general human population; fisheries participants; aboriginal people; youth; women; coastal communities
22. **Human Geographic Region:** country; province; region; community; First Nation territory

23. **Services:** education; housing; daycare; medical care
24. **Education:** primary school, some high school; high school graduate; some postsecondary; postsecondary certificate or diploma; bachelor's degree; master's degree; PhD
25. **Seafood:** by species grouping (e.g., salmon, groundfish); species (e.g., chum salmon, prawns); gear and species (e.g., gillnet-caught chum salmon)
26. **Adjacent:** within 10 miles; within 100 miles; in province; in country
27. **Product Category:** landed; processed; available for sale; consumed; exported from
28. **Processing Type:** fresh; fresh-frozen; frozen-at-sea; smoked; fish product (e.g., surimi); canned; fishmeal
29. **Certification Standards:** occupational first aid; marine emergency duties; master's ticket; engineer's ticket
30. **Data:** federal fisheries data that does not violate privacy, confidentiality or national security requirements; federal fisheries catch data; federal; fisheries stock assessment data; federal fisheries quota transaction data; provincial fisheries processing data; fisheries ownership data
31. **Fishery Related Website:** DFO website; industry association website; community association fisheries website; ENGO fisheries website
32. **Organization Condition:** number of; participation rates in; funding for
33. **Organization:** arts organizations; cultural institutions; social organizations; environmental organizations; political organizations; industry associations
34. **Jurisdiction**: federal; provincial; municipal; First Nation
35. **Qualitative:** survey; focus group; interview; public hearing; public inquiry; study; legal proceedings; media article
36. **Well-being Index:** OECD Better Life Index; Genuine Progress Index; Gross National Happiness; Human Development Index
37. **Economic Unit:** Individual; enterprise; fishery; industry
38. **Stakeholder Group:** Aboriginal communities; Industry; Resource Users; Regional government; Community groups; Environmental interests; Provincial Government
39. **Compensation:** payment; wage; share; bonus
40. **Sector:** commercial; recreational; food; cultural
41. **Access:** open access; license; quota; individual property right; hereditary right; communal property right
42. **Operator Type:** processor with fisheries access rights; non-participating access owner (investor); owner-operator; active fishermen without ownership access
43. **Fisheries Related Private Infrastructure:** vessels; processing plants; service providers; manufacturers
44. **Fisheries Related Public Infrastructure:** wharves, docks, piers; coast guard facilities; research stations and vessels; stock enhancement facilities
45. **Benefit Axis:** employment; access (quota, license); physical capital (e.g., vessels); income; revenue; food; opportunity
46. **Socio-economic Distribution Axis:** gender; age; sector; fishery; region; community; enterprise; vessel; harvester; individual
47. **Cost Axis:** loss of capital; loss of human life; human health impacts; habitat loss; ecosystem service losses; opportunity costs; foregone revenues
48. **Value Type:** landed value; export value; wholesale value; retail value
49. **Value Chain Element:** producer; processor; wholesaler; retailer; consumer; investor
50. **Risk Axis:** ecological; financial; economic; health; cultural
51. **Livelihood Index:** Sustainable Livelihood Security Index; Economic Security Index

52. **Human Demographic Axis:** age; sex; place of residence; aboriginal status; education; income level
53. **Occupational Axis:** skipper; deckhand; tenderman; diver; shoreworker; technician; fisheries observer; fisheries scientist; processor; fisheries manager; fisheries researcher
54. **Productivity:** labour productivity; multi-factor productivity; capital productivity
55. **Efficiency:** allocative efficiency; productive efficiency; technical efficiency
56. **Financial ratio:** cash ratio; current ratio; effective tax rate; return on equity; debt to equity; cash flow to debt; price/earnings ratio; dividend yield
57. **Agreement:** conditional sales agreement; trust agreement; minimum price agreement; collective agreement
58. **Experience:** months or years working in industry; position (deckhand, skipper); fisheries
59. **Labour tactic:** strike; blacklist; boycott
60. **Financial Information:** license value; quota value; share value; wages; price; revenues; costs; profits; stock status
61. **Legislation/Regulation:** *Fisheries Act*; *Oceans Act*; Marine Stewardship Council (MSC) requirements; industry association regulations
62. **Market Failure:** corporate concentration; insider trading; undue market control; transfer pricing; price gouging; price-fixing
63. **Enforcement:** arrest, prosecution, fine, jail term
64. **Economic Variables:** price; rent; subsidies; externalities; consumer surplus; producer surplus
65. **Institutional Arrangement:** legislation; regulation; policy; programs; management structures
66. **Management Plan:** IFMP; marine use plan; land use plan
67. **Support:** financial; human resources; technical; logistical
68. **General Management Activity:** planning; policy-making; data collection; research and analysis; decision-making; audit and evaluation; training; administration; communications
69. **Fisheries Management Activity:** monitoring; enforcement; stock assessment; research; habitat monitoring; habitat protection; habitat restoration; habitat enhancement; harvest planning; harvest management
70. **Conflict Resolution Approaches:** Facilitative approach; Mediation; Negotiation; Arbitration; Rights based Court system; Rule based processes; Transformative approach; Interest based approach; Evaluative approach; Activist approach; Narrative approach
71. **Agreement Element:** goals & objectives; terms of reference; statement of roles and responsibilities; duration and renewal conditions; liability and accountability provisions; dispute resolution mechanisms; audit and evaluation conditions
72. **Collaboration Type:** public-private partnerships; private-social partnerships; co-management
73. **Collaboration Criteria:** power-sharing; information-sharing; shared rule-making; multi-party agreements signed and/or renewed; multi-party management plans
74. **Co-operation Criteria:** disputed decisions; disputes resolved; availability of third party conflict resolution services; use of third party conflict resolution services; ministerial intervention
75. **Inclusivity Criteria:** access to funding; access to other resources; attendance at meetings; participation rates at public hearings; travel time between fishing communities & meeting locations; membership in stakeholder groups
76. **Information Standards:** allocation decisions include explicit trade-off analysis; decisions include risk assessment; peer review of science; knowledge of legal and regulatory framework; indicators are SMART; use of EBM approaches; application of Precautionary Approach; incorporation of local and traditional knowledge; multi-disciplinarity; MSE;

Bayesian Decision Networks

77. **Predictability Criteria:** clearly established and communicated processes for decision making; following plain meaning of a process or provision; pursue process as it was intended by drafters; follow precedent
78. **Flexibility Criteria:** adherence to process and precedent; consideration of range, time, change, conditions of uncertainty and favourability; consideration of trigger events, trigger states, decisions and choices; distinguish between flexible, inflexible and degrees of flexibility
79. **Transparency Criteria:** availability of information; usability of available information; public release of rationale for decision
80. **Compliance Criteria:** conformation to rules, regulations, plans, policies, standards, agreements, laws and administrative specifications; requirement of and conformity to covenants of permits, certificates, licenses or leases; penalties in place to address infractions such as fines, seizure of harvest
81. **Power Dynamics Criteria:** sources of power imbalances (personal, relational, data, technological, professional, structural, educational, capacity etc.); types of power relations (citizen, delegated or power over, partnership or power with, powerless, empowered, coercive, cooperative); power holders
82. **Rule Level:** constitutional level; collective level; operational level
83. **Accredited Organization Criteria:** represents members; requires members to pay an annual due; maintains a duly elected executive; has established and maintains a reporting mechanism; has made required filings and registration with appropriate public bodies; maintains minimum membership size
84. **Trade-off Criteria**: qualitative and quantitative frameworks to discuss trade-offs; clarified decision context**;** clear statement of and justification for trade-offs; evaluation and selection of trade-offs; assignment of ranks or preferences for alternatives; estimation of risk (objective and subjective)
85. **Assessment Method:** performance-based audit; program evaluation; fishery management plan evaluation; third-party fisheries certification assessment; management strategy evaluation; CFRN indicator framework

Appendix B - Semi-Structured Survey Questions

Interview Questions (22): Semi-structured face-to-face key informant interview. (Attention: You may skip any question you are not willing to answer without penalty)

The author repeated all questions for each participant within all fisheries examined

1. Can you please tell me about your history with the fishery?
a. What is your status within the harvesting sector?
b. When did you start working?
c. For how many years?

2. Were there any changes during your involvement with the fishery?
a. Reduction, loss, or gain in landed value?
b. Reduction, loss, or gain of ownership of license(s), and/or quota?
c. Loss or gain in the number of vessels you owned or within the community (if applicable)?
d. Reduction, loss, or gain of employment?
e. Reduction, loss, or gain of income?

3. What are some of the current rules (regulation, legislation, policy, and management measures) for the fishery?
a. Have these changed over the years?
b. If yes, how so?
c. In your opinion, have these regulations changed your (or others) employment, income, share of revenue, or ownership (licenses and number of vessels)?
d. If yes to any, please explain in detail.

4. What is your perception of: a) how have the overall distribution of benefits changed within the fishery in Grand Manan, NB, b) how have the overall distribution of benefits changed between communities in the region for this fishery, and c) how have the overall distribution of benefits changed between individual harvesters (e.g. owner, captain, officers, cook, crew, and between men and women) in Grand Manan, NB, for this fishery?
a. In your opinion, which groups are benefiting the most from the fishery?
b. In your opinion, which groups are benefiting the least from the fishery?
c. Please compare how benefits are shared between individuals of this harvesting sector – if there is a wide spectrum of distribution of benefits.

d. How have the benefits that you have received from the fisheries changed over the years (1960's – 2014) in comparison to other individuals within this harvesting sector?
e. How has the distribution of fishing benefits changed over the years (1960's-2014) in Grand Manan, NB, compared to other communities within the Maritimes Region?

i. For example: what is the % employment in Grand Manan, NB (for this fishery), how has this changed over the years, and how does this compare to the changes in % employment (for this fishery) within the Maritimes Region of Atlantic Canada, over the years (1960's – 2014)?

Table 10. List of indicators developed to measure the distribution of community fishing benefits.

Landed Value
Number of Licenses (Change in Access)
Number of Vessels
Employment
Income

Appendix C – Change of Access Data

Number of licences				
Year	Herring	Groundfish	Lobster	Total
1998	10	12	133	155
1999	11	10	133	154
2000	11	10	131	152
2001	10	9	128	147
2002	9	9	128	146
2003	9	9	128	146
2004	7	9	124	140
2005	7	9	138	154
2006	7	9	131	147
2007	7	9	146	162
2008		9	132	141
2009		9	124	133
2010		7	122	129
2011		7	122	129
2012	0	7	123	130

Appendix D – Change in Adjusted Landed Value

Landed Value (Adjusted)			
Year	Herring	Groundfish (cc	Lobster
	Value ($)	Value ($)	Value ($)
1980	7,289,301.09		3,950,468.04
1981	1,633,314.87		5,684,997.17
1982			6,193,477.85
1983	458,104.32		5,552,135.98
1984	565,760.32		6,026,190.17
1985	1,890,437.77	98,626.14	4,885,939.19
1986	415,726.95	183,210.57	5,188,890.73
1987		597,219.23	5,752,801.04
1988	200,090.69	529,997.12	6,719,220.93
1989	215,878.99	315,445.39	5,124,721.07
1990	184,700.04	245,610.84	5,160,354.62
1991	170,530.43		5,511,269.32
1992	67,475.01	57,759.97	5,796,157.67
1993	115,440.89		5,993,873.57
1994	95,600.50		8,182,871.59
1995	112,207.02		9,783,979.47
1996	95,756.14		8,571,960.08
1997	30,952.01		9,408,141.67
1998			10,679,588.85
1999			15,802,329.53
2000			14,090,609.63
2001			16,819,480.70
2002			18,034,469.29
2003			16,613,305.90
2004			14,629,585.46
2005		0.00	25,558,489.65
2006			21,593,848.23
2007			18,512,858.26
2008			20,458,582.15
2009			17,956,117.29
2010			21,405,053.90
2011			25,120,920.94
2012	0.00		23,176,358.99

Appendix E – Change in Regional Lobster Licenses

	Lobster Fishing Area						
	33	34	38	38 Comm	35	36	38B
1998	728	981	133	2	96	178	
1999	723	979	133	3	96	177	
2000	717	981	131	6	94	177	
2001	712	971	128	9	93	177	
2002	710	965	128	9	93	176	
2003	708	964	128	9	92	174	
2004	706	958	124	13	88	171	
2005	703	953	121	16	86	170	17
2006	703	955	121	16	85	168	10
2007	702	953	121	16	85	168	25
2008	691	953	121	16	85	167	11
2009	677	952	112	16	85	165	12
2010	670	941	109	16	85	164	13
2011	660	936	106	16	85	162	16
2012	653	929	106	16	85	162	17
2013	644	923	104	16	85	159	23
2014	637	920	104	16	85	157	40

Appendix F – Change in Regional Lobster Landed Adjusted Value

Lobster Fishing Area						
Year	33	34	35	36	38 & 38B	Total
1979	6,636,239	55,086,175	1,990,829	2,728,098	5,135,125	71,576,466.04
1980	4,859,186	55,244,893	1,287,938	2,829,490	3,950,468	68,171,975.94
1981	5,747,880	54,907,871	1,953,657	2,501,081	5,684,997	70,795,486.08
1982	7,151,084	60,716,267	2,158,204	3,398,963	6,193,478	79,617,995.98
1983	11,951,626	75,504,321	1,948,013	3,153,287	5,552,136	98,109,383.81
1984	22,660,825	89,808,018	3,419,460	3,664,252	6,026,190	125,578,745.01
1985	31,724,479	90,812,814	3,808,426	4,846,564	4,885,939	136,078,222.61
1986	45,705,568	126,649,115	4,721,483	4,677,529	5,188,891	186,942,584.43
1987	45,415,487	135,807,480	5,999,994	5,583,939	5,761,377	198,568,277.05
1988	30,302,490	115,887,391	4,208,723	4,577,850	6,714,012	161,690,465.74
1989	25,682,385	111,001,928	3,816,504	2,836,927	5,124,722	148,462,464.63
1990	24,478,568	114,427,589	2,997,100	2,939,523	5,160,354	150,003,133.85
1991	26,236,932	118,863,716	3,274,178	2,815,576	5,511,269	156,701,670.74
1992	21,923,402	121,793,017	3,428,783	2,773,793	5,811,180	155,730,176.24
1993	23,892,822	119,982,153	2,938,012	2,894,803	5,975,451	155,683,240.08
1994	23,103,639	153,844,954	4,643,697	4,145,964	8,150,177	193,888,432.54
1995	28,838,487	164,097,491	6,807,608	4,887,653	9,774,335	214,405,573.52
1996	27725426.29	167133652.6	11117921.66	9435102.978	8570173.146	223,982,276.66
1997	27,691,062	175,314,667	13,425,737	9,560,542	9,408,141	235,400,149.49
1998	33,263,538	197,717,476	13,230,951	11,820,242	11,399,574	267,431,780.97
1999	40,599,863	260,974,123	16,909,631	15,570,346	15,802,329	349,856,292.76
2000	37,259,700	241,498,850	17,336,561	14,626,471	14,090,610	324,812,191.14
2001	42,850,604	297,314,874	20,062,933	17,824,612	16,819,481	394,872,503.32
2002	36,567,678	300,367,189	21,853,860	19,060,999	18,039,363	395,889,088.57
2003	39,494,546	310,469,430	20,134,283	18,684,759	17,067,744	405,850,761.71
2004	32,894,977	263,160,485	18,246,970	16,027,581	15,550,694	345,880,705.89
2005	44,257,629	300,488,888	21,069,757	20,194,183	25,632,119	411,642,575.17
2006	39,618,404	246,066,050	19,839,593	15,694,186	21,746,216	342,964,449.81
2007	34,718,352	200,361,496	16,622,210	13,720,379	18,512,858	283,935,295.08
2008	33,912,754	210,983,798	17,252,342	15,380,059	20,458,582	297,987,535.14
2009	32,096,451	186,333,315	18,081,104	15,369,822	18,387,197	270,267,888.02
2010	37,143,383	210,212,240	23,527,213	16,446,988	21,730,096	309,059,920.33
2011	39,573,393	196,827,103	29,520,625	19,846,664	25,426,527	311,194,312.09

Appendix G – Regional Distribution of <65ft Mobile Groundfish Licenses

Year	Pubnico	Yarmouth	Grand Manan	Remain NS	Remain NB	Other (Nonspecified)	Total
1998	68	38	12	213	0	28	359
1999	67	37	12	202	0	28	346
2000	63	36	10	186	0	26	321
2001	66	37	10	182	0	31	326
2002	67	37	9	174	0	32	319
2003	64	35	9	170	0	31	309
2004	63	35	9	165	0	34	306
2005	64	35	9	171	0	27	306
2006	64	36	9	168	0	27	304
2007	63	36	9	174	0	20	302
2008	70	35	9	165	0	23	302
2009	63	43	9	160	0	23	298
2010	66	44	9	154	0	24	297
2011	70	43	7	144	0	33	297
2012	75	41	7	138	0	33	294
2013	78	42	7	131	0	35	293