IS REBUILDING COLLAPSED FISHERIES A WICKED PROBLEM? LESSONS FROM A FISH CHAIN ANALYSIS OF NORTHERN GULF COD FISHERIES

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Abstract

As with many collapsed fisheries worldwide, the rebuilding of Newfoundland's Northern Gulf cod fishery has been a huge challenge to coastal communities, resource users, scientists, and policy makers. Almost twenty years after a moratorium was declared in the early 1990s, the cod stocks are below conservation limit reference points; only small quotas are available for commercial and recreational fisheries, and a strong possibility exists that the stocks will be listed as endangered. Not only have these and other regional Atlantic cod stocks been slow to rebuild, the cod fishing industry also faces challenges along the production chain, from harvesting to processing, and marketing. While the fishing industry has been restructured from reliance on groundfisheries towards an emphasis on shellfisheries, challenges persist and fishing dependent communities in regions such as the Great Northern Peninsula are struggling to survive.

A review of global experience with rebuilding collapsed fisheries demonstrate that rebuilding is a 'wicked' problem; meaning that the challenges go beyond scientific and technical solutions, to socioeconomic and sociopolitical concerns. Rebuilding differs from recovery in that it perceives fisheries as coupled social-ecological entities connected to larger societies and the global economy. Rebuilding also takes into account both current and future generations and related equity issues including who pays for the costs of rebuilding and who benefits in the long term. The imperatives for rebuilding fisheries are multidimensional and include food security, livelihoods, revenue, cultural heritage, and ecosystem services. Using a case study of Newfoundland's Northern Gulf cod fisheries, the thesis examines the reasons why rebuilding collapsed fisheries is a wicked problem, and explores governance options for dealing with such multifaceted problems. It employs a 'fish chain' approach (that entails three production stages – the pre-harvest, harvest, and post-harvest stages) in order to generate insights into why the stocks collapsed in the early 1990s, identify reasons for the stalled rebuilding, as well as seek opportunities for collaborative rebuilding

efforts. The analysis relies on existing statistical data, peer-reviewed literature, taskforce and policy documents, and findings from key informant interviews conducted along the fish chain for the pre- and post-collapse era.

The case study findings suggest that ecosystem changes, fishing patterns, transitional livelihood options, changing global seafood markets, consumer preferences for certified seafood, power relations, and policy instruments at different stages in the fish chain have contributed to stall rebuilding. These factors illustrate how and why rebuilding collapsed stocks is a wicked problem. Findings along the fish chain also indicate that rebuilding could be facilitated using multispecies and ecosystem-based approaches that pay attention to by-catch and discards; incorporating effective gear use policies, stewardship incentives, integrated livelihood programs, seafood value-addition, and bridging scale-mismatches between ecosystems, fishing activities, and institutions. Addressing distributional and intergenerational equity concerns, community capacity building, along with changes in power relationships between stakeholders are central to successful rebuilding in the longer term. Related to this, the analysis suggests that 'clumsy' governance options that bring together insights from diverse perspectives from multiple stakeholders could play a key role in creating more institutional spaces towards rebuilding. Some of these clumsy options include stronger support for bottom-up initiatives that respond to regional economic development needs; the development of effective co-governance arrangements with stakeholder and community groups; marketing initiatives that take advantage of local, regional and global consumer choices; and meeting local food security needs and stewardship concerns. Finally, institutional partnerships across different levels of government, in addition to industry and civil society inputs, are critical to rebuilding collapsed groundfisheries in Newfoundland and could provide lessons for efforts to rebuild fisheries worldwide.

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Chapter I: Introduction and Overview

Introduction

Seafood is currently the most traded commodity internationally, with global exports exceeding 100 billion USD in 2008 (FAO, 2010a). Fish landings and seafood trade have increased tremendously in the past few decades and approximately 80% of wild fish stocks are fully exploited or overexploited (FAO, 2010b). There is growing evidence worldwide that commercial wild capture fisheries are in a state of decline and there is an urgent need for policy and institutional reform to address this situation (OECD, 2007; Worm *et al.,* 2009; World Bank 2008; UNEP, 2009; Hammer *et al.,* 2010). This status of global commercial overfishing raises concerns about biodiversity conservation, the capacity to sustain seafood trade, and food security (Pauly *et al.,* 2005; Smith *et al.,* 2010; Srinivasa *et al.,* 2010). According to Worm *et al.* (2009), around 67% of the world's commercial fish stocks require rebuilding. These include, amongst others, the Atlantic blue fin tuna (*Thunnus thynnus*), Southern blue whiting (*Micromesistius australis*), tropical groupers (*Epinephelus spp.*), Atlantic cod (*Gadus morhua*), European eel (*Anguilla anguilla*), Northern and Southern hake (*Merluccius merluccius*), Patagonian tooth fish (*Dissostichus eleginoides*) and orange roughy (*Hoplostethis atlanticus*), as detailed in Caddy and Agnew (2005); FAO (2010b); and Wakeford *et al.* (2009).

Fisheries contribute tremendously not only to world trade, but also to regional and community well-being. They provide livelihoods for nearly half a billion people worldwide and are a source of affordable protein for a global population, with average per capita fish consumption reaching a record high in 2008 (FAO, 2010b). Revenue from seafood trade is necessary for sustaining the global economy and particularly important for developing countries' foreign exchange (Dyck and Sumaila, 2010). The current state of the world's capture fisheries is threatening the nutritional well-being of fishing dependent communities, economic sustainability, and the preservation of traditional cultural practices (Chuenpagdee *et al*., 2005). It also generates concerns and disputes amongst policy makers in terms of effective strategies, the scientific community regarding methodological approaches, and changing lifestyles for fishing people and coastal communities.

The imperative to rebuild collapsed fisheries is multidimensional and includes food security, employment, revenue, cultural heritage, empowerment, equity, and ecosystem services. Researchers concerned about this rebuilding imperative endeavor to understand the inter-linkages and interactions across the entire production chain at multiple spatial and temporal scales. The rebuilding imperative differs from the recovery imperative in that it treats fisheries as coupled social-ecological entities connected to larger societies and the global economy. It also incorporates attention to intergenerational concerns (Sumaila, 2004), issues of equity and power (Sinclair and Ommer, 2006), transitional governance, scale mismatches (Crowder *et al.,* 2006), and institutional feedback mechanisms (Osterblom *et al.,* 2011). Institutions are central to the rebuilding imperative as they provide the mechanism and process for policy change and shape the social-cultural meaning that fisheries generate (Jentoft *et al.,* 1998; McGoodwin, 2001; McCay, 2002; Ommer *et al.,* 2007; Armitage *et al.,* 2007; Lowe and Caruthers, 2008).

To date, most institutional responses to collapsed stocks have focused on the resource and the fishing end of the production chain, through reduction in fishing capacity and related efforts to restructure fisheries through rationalization and downsizing the fishing industry. This approach has paid little attention to such issues as equity between fishing sectors and regions and between generations, power dynamics, or to factors further along the fish chain including processing, fishing dependent communities, market dynamics, consumer choices, and regional economic development, which could influence the potential for rebuilding. The lack of attention to scale issues and other organizational and governance complexities has also constrained the opportunities for rebuilding and sustaining fishery ecosystems (Crowder *et al.*, 2006; Ommer *et al.*, 2007; Armitage, 2008; Ekstrom and Young, 2009). Furthermore, thinking in terms of the rebuilding imperative draws attention to the cost of 'doing nothing'; including degraded ecosystems, lost revenue, threats to sustainable livelihoods, conflicts, and food security.

The support for a holistic rebuilding rather than a narrow recovery imperative highlights broader sets of challenges that need to be acknowledged and resolved. These include issues related to compliance with rules, transaction costs associated with control and surveillance, provision of ecosystem services, transitional livelihood options, integrated coastal planning, and pluralism in decision-making. These coastal and governance challenges have been referred to as 'wicked problems' by Jentoft and Chuenpagdee (2009), as originally conceptualized by Rittel and Weber (1973). Wicked problems are complex issues that transcend scientific and technical management and extend to socioeconomic and institutional concerns (Rittel and Weber, 1973). Fisheries governance is particularly wicked due to challenges associated with ecosystem complexity, stakeholder dynamics, governing scales and their overall interactions (Jentoft and Chuenpagdee, 2009). Too often, decision-making arenas related to rebuilding collapsed fisheries are dominated by the perspectives of a limited number of stakeholders concentrated at one end of the production chain, resulting in the marginalization of other viewpoints that are necessary to achieve the rebuilding imperative in fisheries. To achieve the rebuilding imperative, 'clumsy solutions' (Verweij and Thompson, 2006) that incorporate multiple viewpoints and strategies to address environmental, sociopolitical, and socioeconomic concerns could be more effective in addressing the particularly wicked rebuilding problems than simply relying on management panaceas (see Ludwig, 2001; Ostrom *et al.,* 2007).

A growing body of literature points to effective governance as vital for sustaining fisheries that are profitable, equitable, and socially just (Charles, 2001; Gray, 2005; Schechter *et al.,* 2006; Grafton, 2007; Lowe and Carothers, 2008; World Bank, 2008). Thus, governance is also an essential prerequisite for achieving the rebuilding imperative (Kooiman *et al.,* 2005; Ommer *et al.,* 2007). Although there are many definitions of governance in the social and policy sciences (Ostrom, 1990; Peters, 2001; Rhodes, 2007), it generally implies going beyond governments and state management, to include contributions from civil society and the private sector (Kooiman, 2003; Kjaer, 2004).

According to the interactive governance theory (Kooiman *et al.*, 2005), fisheries governance is understood as "the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them" (Kooiman *et al.,* 2005:17). Fisheries governance is multidimensional and underscores the importance of interactions among ecological, social, economic, cultural, legal, and political processes (FAO, 2001; Gray, 2005). It involves understanding issues of problem identification, agenda setting, institutional design, policy instrument choice, as well as the relevance of these considerations for successful governing outcomes (Bavinck *et al.,* 2005).

The above argument for a rebuilding imperative offers an opportunity to understand how governance and institutional mechanisms can both facilitate fisheries rebuilding and sustain fisheries once rebuilt. Power is central to rebuilding; as noted by John Gaventa, "simply creating new institutional arrangements will not necessarily result in greater inclusion or pro-poor policy changes. Rather, much depends on the nature of the power relations which surround and imbue these new, potentially more democratic spaces" (Gaventa, 2006: 23). The remainder of this introductory chapter is arranged in two parts starting with a problem statement and general discussion of the research design, followed by an overview of the manuscript chapters.

Problem statement and research design

A 'fish chain' approach to the problem of rebuilding collapsed fisheries suggests that instead of relying on management panaceas, we need to see collapsed fisheries as complex and dynamic social-ecological entities characterized by processes that operate at multiple scales and by various stakeholder groups and governing actors across numerous institutions and jurisdictional boundaries. The fish chain is a governance perspective and an analytical approach that looks at the interaction between the various production stages, stakeholder groups, and policy instruments (Bavinck *et al.,* 2005). The production stages include the pre-harvest stage (marine ecosystems), harvesting stage (fishing activities embedded in coastal communities), and the post-harvest stage (processing, marketing, and consumption). Given the wicked governance challenges associated with rebuilding collapsed fisheries, more research is needed to better understand the opportunities, constraints and options for effective rebuilding in different context and to identify potential ways to tackle this 'wickedness'.

More specifically, what is lacking in the current literature is a holistic understanding of how multi-scale fish chains, diverse governing actors, dynamic policy processes, and various institutions interact with ecological processes to constrain rebuilding. Additionally, there is little research on how the nature of these interactions could potentially be adapted or changed to promote more effective and holistic rebuilding efforts. In these contexts, the overarching research question addressed in this thesis is: what are the challenges associated with rebuilding collapsed fisheries and what strategies might be effective in achieving the rebuilding imperative?

Drawing on the interactive governance theory (Kooiman *et al.*, 2005), this thesis argues for holistic approaches that consider ecological, socioeconomic and sociopolitical concerns, including notions of equity and power relations, and how this kind of approach might improve our understanding of rebuilding and help us achieve better social-ecological outcomes. Methodologically, the research question is addressed by first reviewing fisheries collapses globally, presenting evidence that locally and internationally, there is an imperative for us to figure out how to effectively rebuild collapsed fisheries including not only the resources but the industries and communities that depend upon them in an equitable and sustainable manner. A case study of the Northern Gulf of St. Lawrence cod fisheries in Eastern Canada is used to illustrate the challenges around the rebuilding of collapsed fisheries. A comparative pre- and post-collapse analysis of the fish chain is conducted to understand the rebuilding challenges associated with the Northern Gulf cod fisheries and to identify potential governance opportunities for rebuilding.

In fisheries, as in other resource-based industries, the 'chain' metaphor is used in various contexts and in different ways. It is used in research on value chains for fish products (Gudmundsson *et al.,* 2006), and on up-scaling and firm behavior in global production chains (Bernstein and Campling, 2006; Wilkinson, 2006). The 'fish chain' approach is distinguished from other chain approaches such as work on 'global commodity chains' or 'value chains' used in the consumer goods industries (Gereffi, 1994; Kaplinsky and Morris, 2001) by its focus on understanding fishery systems across the entire production chain including ecosystem dynamics and the human dimension of markets, stakeholders, and institutions (Bavinck *et al.,* 2005;

Thorpe *et al.*, 2005). The fish chain also pays attention to various scales of production and stakeholder interactions; including a good understanding of ecosystem and resource boundaries, fishing activities and fleet mobility, processing and distribution networks, households and coastal community linkages, to administrative and jurisdictional boundaries (Kooiman *et al.*, 2005). The fish chain approach builds on the geographical tradition of human-nature scholarship (Gober, 2000) and its relevance to research on public policy and governance (Massey, 2000; Martin, 2001; Vodden, 2009). The approach also emphasizes concerns about economic globalization, environmental governance, biodiversity loss, and the commodification of nature (Liverman, 2004; McCauley 2006; Bair, 2009).

In essence, the fish chain approach thinks in terms of social-ecological systems and draws attention to the strong relationship between humans and their environment, and to human dependency on nature and resources for survival. This approach is, in part, a reaction to anthropocentric perspectives to nature and growing recognition of the limits to human control (Odum, 1983; Berkes and Folke, 1998). These related ideas have been applied within fisheries in relation to a wide array of governance issues (see Charles, 2005; Folk *et al.,* 2005; De Young *et al.,* 2008; Armitage *et al.,* 2009; Ostrom, 2009).

The fish chain framework is used as analytical tool to understand the challenges and opportunities towards rebuilding of collapsed fisheries. The Northern Gulf cod (*Gadus morhua*) stock is one of ten stocks (4RS3Pn) that collapsed in various Northwest Atlantic Fisheries Management regions in eastern Canada in the early 1990s (Figure 1). The multiple collapses led to two moratoria imposed on Northern Gulf cod between 1994 and 1996 and again in 2003, and a massive reduction in total allowable catches (TAC) that continues to this day.

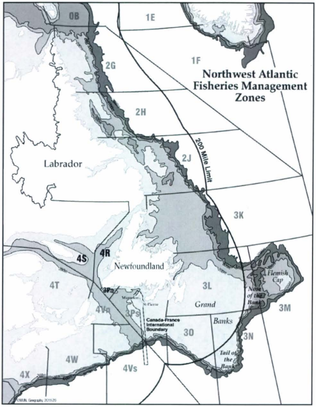

Figure 1: Northern Gulf cod stocks (4RS3Pn) in the Gulf of St. Lawrence in eastern Canada

Since the early 1990s, several management measures and restructuring efforts have been attempted to achieve stock recovery and a sustainable fisheries in the region (Cashin, 2003; GNPFT, 2006). The cod stocks in the Northern Gulf and other parts of the region have not rebuilt and the fishing industry continues to be far from sustainable despite two decades of programs focused on reduced catches and industry downsizing. Most recently, a report that developed out of a Memorandum of Understanding (MOU) between key parts of the fishing industry and the provincial government of Newfoundland and Labrador (NL) documented the ongoing challenges of NL fisheries. The MOU recommended key policy initiatives to further downsize the fishing industry as the solution to ongoing fragilities and the risk of industry collapse (Clift and team, 2011). To achieve these rationalization goals, almost half a billion Canadian dollars (CAD) in government funding was requested. This funding would, if provided, be in addition to previous restructuring public investments of approximately CAD $4 billion spent from the early 1990s to 2005 (Rice *et al.,* 2003; Ruseski, 2008).

The substantial industry downsizing proposed in the MOU study would have significant implications for already vulnerable small-scale fish harvesters and for equity and social justice at the level of individual communities and regions, particularly fishery dependent regions such as the Great Northern Peninsula on Newfoundland's west coast. Further downsizing would contribute to even greater concentration of access of the resource and allocation of quotas and would seriously threaten the socioeconomic foundation of many coastal communities. Furthermore, there are no guarantees this would produce a sustainable multi-species fishery or enhance the potential for groundfisheries rebuilding. The MOU recommendations had, as of December 2011, been rejected by the NL provincial government[1] and this inaction has spurred concerns about the future of the fishery (see Walsh, 2011).

While much has been written about the mismanagement of the cod stocks that led to the collapses and about the ecological constraints on recovery (e.g. Storey, 1993; Hutchings and Myers, 1995; Hannesson, 1996; Rose, 2007), there is still relatively little research that seeks to systematically address the rebuilding imperative for these fisheries including the associated challenges and essential governance mechanisms that might be required to achieve this goal (see Vodden *et al.,* 2005; Ommer *et al.,* 2007). In Canada and in many other parts of the world, fisheries collapses have generally led to initiatives that focused mainly on stock recovery, through attention to reference points and indicator systems that monitor productivity in the

[1] http://www.cbc.ca/video/#/News/Canada/NL/1279609329/ID=1818322846 Last accessed March 12th 2010.

growth and reproduction of fish stocks (FAO, 1999; Garcia and Staples, 2000; Rice and Rochet, 2005). These indicator systems and reference points are essential for monitoring ecosystem health and include the assessment of maximum sustainable yield (MSY), the spawning stock biomass, recruitment of age classes, and rates of growth of fish from juvenile to maturity (Rice *et al.,* 2003; Caddy and Agnew, 2005; Murawski, 2010). However, limited attention has been paid to biodiversity considerations and to the potential role of regime shifts and multispecies interactions in stock rebuilding (Government of Newfoundland and Labrador, 2003; Bundy *et al.,* 2009; Morissette *et al.,* 2009). Furthermore, the institutional dimension of rebuilding such as appropriate policy reforms and multi-level partnerships, along with social objectives for dependent coastal communities, have not been fully incorporated into rebuilding strategies and initiatives (Degnbol and McCay, 2006; Belbin, 2007).

The coastal communities in the Northern Gulf of St. Lawrence have historically depended heavily on the groundfisheries resources (Felt and Sinclair, 1995; Hamilton *et al.,* 2004; Canada-Quebec, 2005). The cod fishery was traditionally based on 'domestic commodity production' with parts of it gradually evolving into 'petty capitalist' production in the early 1980s (Sinclair, 1985; Palmer and Sinclair, 1997). Northern Gulf cod fisheries transitioned from small-scale production in the 1950s to include more industrial and commercial production in the 1980s (Sinclair, 1985; Wright, 2001). There was also a corresponding shift in commercial target from groundfisheries to shellfisheries that accelerated rapidly after the groundfish stocks collapsed in the early 1990s. Expanded seasonal eco-tourism services and the higher economic value from shellfisheries have not, however, been associated with more stable or better rewarded employment in Newfoundland, particularly for fish processors and small scale harvesters (Schrank, 2005). Similar concerns are evident in Quebec in the 4S region (Figure 1), particularly on the Gaspé Peninsula and Quebec North Shore where fishing is also a historical and core livelihood activity. The number of cod license holders in the Quebec region decreased by 60% from 1985 to 2002 and total landed values declined by 17% (Canada-Quebec, 2005). Other ongoing challenges in the Northern Gulf region include major out-migration, an aging population, limited youth involvement in fisheries, low incomes, and a loss of export revenues due to macroeconomic factors (GNPFT, 2006; FFAW, 2008).

The geographical isolation of the coastal communities in western Newfoundland and the high level of dependency on fisheries resources, along with poor financial and technical infrastructure and limited livelihood options, made this region extremely vulnerable to the consequences of resource collapse (Felt and Sinclair, 1995; Hamilton and Butler, 2001; Ommer *et al.,* 2007). According to some researchers and several task force reports, the region's survival now depends on the collective efforts of community partners and federal-provincial agencies in creating an effective governing framework for decision-making with active local involvement (Felt and Sinclair, 1995; GNPFT, 2006; Belbin, 2007; Vodden, 2009). Integrated livelihood strategies, labour market changes, and regional and municipal economic planning have not been fully incorporated into rebuilding strategies (Ruseski, 2007; Sinclair and Neis, 2008). Related to this, the Northern Gulf region lacks a comprehensive fisheries rebuilding plan that explicitly outlines implementation strategies, timelines and targets, and specific roles and responsibilities for stakeholder groups.

The fish chain analysis carried out in this thesis highlights the need for and potential benefits of this expanded approach to rebuilding. The case study asks three central questions:

- How have changes (or the lack thereof) in marine ecosystems, socioeconomics, and fisheries policies pre- and post-collapse affected rebuilding?

- What are the policy implications of stalled rebuilding for fishing-dependent communities on Newfoundland's west coast?
- What governing mechanisms and institutional arrangements might promote stewardship, compliance, and equitable fisheries rebuilding for both current and future generations?

Specifically, this thesis seeks to:

- Identify and assess how fisheries policy changes have affected cod fisheries rebuilding prospects and the viability of fishing dependent coastal communities (Chapter III);
- Analyze how seafood production and global markets have affected local rebuilding prospects and the long-term social and economic viability of the fishing industry and coastal communities (Chapter IV);
- Examine how entrenched viewpoints, power structures, equity and social justice concerns, and institutional arrangements contributed to the collapse and have mediated opportunities for rebuilding (Chapter V);
- Synthesize key findings regarding rebuilding challenges and governing opportunities for Northern Gulf cod fisheries and provide lessons of potential relevance to those seeking to rebuild collapsed fisheries elsewhere (Chapter VI).

The research design entails triangulation techniques and mixed methods (Hakim, 1987; Sabatier, 2007). The thesis employs a multi-scale approach including attention to ecosystem interactions and resource management boundaries, fishing activities, key actors, institutions, and policy instruments along the Northern Gulf cod fish chain. The research was carried out in three stages. First, a literature review and document analysis of peer reviewed scientific material and of technical and task force reports was carried out related to collapsed fisheries around the world to see what could be learned from experience with efforts to rebuild collapsed fisheries in other contexts. The focus then shifted to the case study of the Northern Gulf cod fisheries and an analysis of published research and reports, including seafood market reports, and taskforce and commissioned reports. In addition, existing statistical data on catch and landings, value, trade flows, and demographics were collected and analyzed.

Second, informal discussions with key stakeholders were undertaken to document fishing activities at harbors and wharves, plant processing methods and infrastructures, retail markets, and restaurants. Third, semi-structured interviews were conducted with fifty key informants from diverse stakeholder groups along the fish chain. The fifty key informants included representatives from six main categories of stakeholders who occupy or had occupied different positions along the fish chain. They included stakeholders with more than twenty years professional and work experience to ensure they could contribute to a pre- and post-collapse analysis. These key informants were:

- Scientists and fisheries managers knowledgeable about resource conservation and ecosystems in the Northern Gulf;
- Resource user groups, especially fish harvesters[2];
- Entrepreneurs in the processing and retail sectors, as well as plant workers;
- Municipal councilors and community planners;
- Current and former decision-makers at various organizational levels including federal and provincial governments, inter-governmental organizations, as well as industry and trade union representatives; and,
- Researchers and analysts from consulting firms and academia, conservation groups, and other civil society representatives, and members of the media.

[2] The term fish harvester is used consistently in this thesis to refer to fishers and other resources users with access rights. The term is widely used in the Newfoundland and Labrador context especially by the Fish, Food and Allied Workers Union (FFAW).

Forty six interviews were done face-to-face, using a combination of audio-recording and note-taking with informed consent. Four interviews were done over the phone. These telephone interviews were conducted when face-to-face interviews were not feasible. A field assistant helped with note-taking for forty of the interview sessions.

The interviews lasted between one and two hours and focused on three to seven themes depending on the occupation and knowledge of the key informant about various aspects of the fish chain. The themes included: i) the status and prospects of restored ecosystems and their potential role in the rebuilding of the Northern Gulf cod fisheries; ii) scientific information necessary for effective rebuilding and management efforts; iii) socio-economic and livelihood concerns; iv) issues related to institutional and organizational decision-making; v) the attitudes, social norms, and stewardship ethics of stakeholders; vi) information and data needs for rebuilding; and, vii) governing mechanisms and initiatives that could contribute to rebuilding.

The interview questions were both open and close-ended allowing for efficient use of time and an opportunity to follow-up on any leads in unexpected directions during the interviews. The interview schedule is divided into two parts: Part I was used to collect demographic information and Part II included specific questions on the fishery. Part II starts with an introductory section for all key informants (Section A), followed by several specialized sections designed to capture relevant knowledge and experience of different groups with experience along different parts of the fish chain. Section B, for instance, deals with fisheries biology and ecosystem science and targets scientist and managers; whilst Section C is intended for resource users such as fish harvesters. Section D in intended to illuminate organizational decision-making in government, industry, and civil society, and targets policy and decision-makers. Two optional sections were included in Part II (Sections E and F), targeting all key informants. These sections were designed to elicit information on attitudes and stewardship concerns, and key informant's sense of understanding of information gaps and data requirements for successful rebuilding efforts. The detailed interview schedule, consent forms, as well as an approval letter from the Interdisciplinary Committee on Ethics in Human Research at Memorial University can be found in Appendices I, II and III, respectively. Bathymetric charts were used during interviews with fish harvesters to collect information on their fishing activities and locations and on their ecological knowledge on stock structure and migration patterns.

Ethical issues around key informant interviews were addressed through guidelines and procedures as set out in the *Tri-Council Policy Statement: Ethical Research Involving Humans*. The key ethical principles in this research included requirements to: i) ensure the free, informed and voluntary participation of key informants; ii) protect the privacy of informants through steps taken to ensure confidentiality; and, iii) ensure participants understood the purpose of the research, who was funding it, and were informed about the potential risks and benefits of participating in the study. Because of these ethical considerations, care was taken to protect key informants through non disclosure of names and the removal of references to specific places that might make it easy to identify the informants. Within these constraints, I have sought to provide enough contextual information to illuminate various stakeholder perspectives on both challenges and opportunities towards rebuilding, within the bounds of the ethical guidelines.

The interview transcripts were arranged and thematically coded to identify areas of consensus, disagreements, or heterogeneity in responses, as they relate to rebuilding challenges and opportunities. The interview transcripts were analyzed using both diagnostic and prescriptive approaches. The diagnostic analysis centered on identifying rebuilding challenges and the prescriptive analysis on identifying rebuilding opportunities and potential policy recommendations. Data were categorized thematically based on the fish chain framework and incorporated into the analysis in the relevant chapters as follows: information and comments on the pre-harvest and harvest stages (Chapter III); information on related fishing activities and on the post-harvest stage, also referred to as the supply and marketing portion of the chain (Chapter IV), and information and comments relevant to an analysis of power dynamics and stakeholder interactions (Chapter V). A synthesis chapter at the end of the thesis encapsulates the main findings and offers policy recommendations (Chapter VI).

Thesis scope and chapter outline

The rest of the thesis includes five chapters developed using the manuscript-style format. Chapter II develops the argument for the rebuilding imperative in global fisheries and introduces the fish chain and clumsy solutions concepts. This chapter was recently published in *Progress in Oceanography* DOI: 10.1016/j.pocean.2010.09.012 (Khan and Neis, 2010). It draws on comparative case study examples of efforts to rebuild collapsed fisheries, and build the argument for a rebuilding imperative. Several policy lessons are offered to illustrate the challenges and lost opportunities associated with failed rebuilding and to argue that while fisheries governance is a wicked problem, rebuilding collapsed fisheries is 'particularly wicked' because of intergenerational equity concerns. Contextual factors that limit or promote rebuilding of entire fish chains are identified, and ways to explore governance mechanisms for rebuilding. The chapter concludes with the suggestion that one way to address the wicked problem of rebuilding collapsed fisheries might be through 'clumsy solutions.' Clumsy solutions strive to bring together the wisdom of diverse entrenched viewpoints relevant to public policy decision-making (such as those characterized by individualism, egalitarianism, hierarchical approaches, and fatalism) and to bring together the stakeholders associated with these perspectives to explore governing options (Verweij and Thompson, 2006). These clumsy approaches may include knowledge synthesis, integrated livelihood programs during rebuilding transitions and beyond, a focus on food security, and attention to fairness and social justice. Moreover, accountability and inclusive decision-making, policy reforms related to responsible seafood trade, compliance and stewardship, as well as power-brokerage, leadership, and institutional innovation are also central to rebuilding and potential aspects of clumsy solutions.

Chapter III shifts from global fisheries to the Northern Gulf cod case study in eastern Canada. This case study introduces and illustrates the wicked rebuilding problems of collapsed fisheries focusing on western and southern Newfoundland (NAFO region 4R3Pn). This chapter is in preparation for submission to the journal *Ecology and Society*. It introduces the fish chain conceptual and methodological approach and focuses on the pre-harvest and harvest stages of the chain and their interlinkages. Various changes in management measures and restructuring programs are itemized, and their impact on the resource and on livelihoods. The primary aim of this chapter is to identify and assess how changes related to the pre-harvest and harvest stages of the fish chain before and after collapse have affected rebuilding prospects for this fishery and the related policy implications for fishing-dependent communities embedded in the production chain. The main factors identified as stalling rebuilding in these two stages of the fish chain include ecological constraints due to ecosystem shifts, the weakening role of science in management, the lack of rebuilding targets, multispecies considerations such as by-catch and discards, on-going livelihood issues, scale mis-matches and institutional inertia. The chapter highlights key policy implications regarding missed stewardship opportunities, the need for livelihood transition strategies and for investments in institutional capacity towards rebuilding.

Chapter IV looks at the marketing and trade aspects at the harvest and post-harvest stages of the fish chain and demonstrates how changes in the pre- and post-collapse periods have affected local rebuilding and economic viability. A shortened version of this chapter was recently published in the *Proceedings of the International Institute for Fisheries Economics and Trade* - IIFET (Khan, 2010). This chapter draws on the backward bending supply model of fisheries (Copes, 1970) and theoretical developments in fisheries management and supply chain governance to inform how seafood production is linked to raw material supply and economic viability, and the significant role of institutions in sustaining the resource. Findings indicate that the cod fish chain has transitioned from producer-driven chains in the pre-collapse period that exports cod blocks to the US markets, to consumer-driven chains in the post-collapse period that emphasizes cod fillets and eco-certified products to mostly UK markets. Furthermore, with the constraints on raw material for groundfish, there has been a shift in target species to shellfisheries, and major related changes in mechanized shellfish processing infrastructure. In the event of full recovery, Northern Gulf cod fisheries thus present a marketing challenge as the cod markets have been replaced by cheaper substitutes such as Alaskan Pollock (*Theregra chalcogramma*) and tilapia (*Tilapia spp*). The chapter concludes with an argument for rebuilding strategies that support social-ecological perspectives and multispecies approaches that address the huge transformation in the processing sector, effective institutional mechanisms for rebuilding policies, and stakeholder partnerships in marketing and value addition especially eco-certification. These recommendations are more likely to promote resource sustainability and economic viability in the event of rebuilding and afterwards.

Chapter V analyzes the role of power relations and governing interactions along the Northern Gulf cod fish chain in the pre- and post-collapse periods showing how these relations contributed to the collapse and hence constrained rebuilding. This chapter is in preparation for submission to the journal *Society and Conservation*. Using Gaventa's (2006) power cube, an analytical model to understand power relations, and not only how to engage but also where and when to engage for policy change towards successful rebuilding; the chapter examines the relationship between power, failed management, and stalled rebuilding. The analysis points to the need to explore governing options that go beyond narrow management measures to broad-based governance approaches if we are to achieve the rebuilding imperative. It delves into how to create 'fields of opportunity' (necessary spaces for negotiating social relationships) for rebuilding via clumsy solutions. The chapter further provides some potential examples of clumsy solutions that could increase the likelihood of successful rebuilding in this region. Examples include community supported fisheries such as in Nova Scotia, catch shares and community-based governance models in the US, and one example of a regional quota allocation scheme for community development in western Newfoundland. These governing examples integrate fisheries rebuilding objectives with community planning goals, livelihood strategies, and bottom-up approaches. They also open up spaces for engaging a broader range of stakeholders across the fish chain and provide a full spectrum of perspectives on rebuilding challenges and potential governing opportunities.

Chapter VI summarizes the main findings in the thesis by synthesizing key aspects from the pre- and post-collapse analyses of the Northern Gulf cod fisheries, and returning to the rebuilding imperative and associated wicked problems. The contribution of the research to the larger literature in this field is described. This includes defining rebuilding collapsed stocks as a 'wicked' problem and seeking to employ a holistic approach through developing a 'fish chain' analysis that includes careful attention to livelihoods, market and consumer preferences, and opportunities and constraints on institutional innovation. This concluding chapter argues that fisheries rebuilding requires governance approaches that are equitable and socially just. Using this social-ecological approach to rebuilding provides opportunities for governing deliberations and creating a platform to explore governing options such as clumsy solutions. Clumsy solutions tap into the strength and viewpoints of the various stakeholder groups along the fish chain for inclusive decision-making towards rebuilding.

The fish chain framework offers a theoretical, methodological, and empirical analysis on the various components and stages of fisheries production from 'ocean to plate'. The approach provides policy entrepreneurship and avenues for participatory decision-making by drawing on diverse key informant insights on ecological complexity, market dynamics, scale issues and institutional fit, and stakeholder partnerships. A broader theoretical reflection is offered on this approach, in addition to limitations of the study, and future research opportunities.

Co-authorship statement

Authorship and supervisory contributions are as follows. Background research, problem definition, study design, interview schedules, ethics application, field work, analysis, and the outlines of the various chapters were primarily carried out by the thesis author, with various inputs from the supervisory committee members. The co-supervisors played key roles in shaping the focus of the thesis through research deliberations in the various SSHRC funded projects (Coastal Connections and CURRA). Specifically, Chapters I, IV and VI were solely written by the thesis author, with comments and editorial suggestions provided by the committee members. For Chapter II (Khan and Neis, 2010), the first author conceptualized the paper, did the research and analysis, and preparation of initial drafts. The second author provided guidance on the logical flow of the argument and suggestions for editorial revisions on subsequent drafts. Three anonymous reviewers provided useful comments and suggestions for the final published draft in *Progress in Oceanography*. The thesis author also handled all review correspondence with editors as stated in the Author Agreement (Appendix IV). For Chapter III (Khan and Chuenpagdee, in prep), the first author conceived the study design, collected and analyzed primary and secondary data, and prepared initial drafts. The second author provided guidance and editorial inputs on the conceptual approach and data analysis. Barb Neis offered comments and suggestions on the final draft. Chapter IV (Khan, 2010) was written by the thesis author and revised in response to comments provided by Rashid Sumaila on the IIFET Proceedings and earlier comments by Barb Neis and Ratana Chuenpagdee. For Chapter V (Khan and Neis, in prep), the first author conceived the study design, collected and analyzed primary and secondary data, and prepared initial drafts. The second author provided additional reading materials and critical feedback related to the theoretical development and revisions on the final draft. Ratana Chuenpagdee provided comments and suggestions on initial and final drafts on both Chapters V and VI.

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Chapter II: The Rebuilding Imperative in Global Fisheries

Introduction[3]

Global marine capture fisheries are in a state of decline, with many commercial species fully exploited or overexploited (FAO, 2009a). There is growing concern that in the absence of major interventions, most commercial fish stocks could collapse beyond sustainable levels (Worm *et al.*, 2007). This paper contributes to the rebuilding imperative by analyzing factors that could lead to successful recovery of overexploited and depleted stocks. The first section of this paper demonstrates that overfishing is interacting with social and economic changes to threaten not only marine ecosystems, but also food security, livelihoods, fishing communities and, in some cases, larger societies (Ommer *et al.*, 2007; Smith *et al.,* 2010). These threats are severe and their consequences are not evenly distributed between countries and regions, or across genders, classes and generations (Le Sann, 1998; Neis *et al.,* 2005). The next section provides a brief overview of the current status of global fisheries and highlights the costs and consequences of resource degradation. It also reviews the existing research on recovery of collapsed stocks, highlighting the frequent failure of recovery initiatives and connects this to the tendency to focus on fish stocks only and reactive changes in management policies. This premise provides a platform to argue for a move towards a 'rebuilding imperative.' The rebuilding imperative differs from the recovery imperative in that it treats fisheries as social-ecological entities and is concerned not simply with the status of fish stocks but also with rebuilding entire fish chains; from marine ecosystems to the harvesting sector, processing, marketing, retailing and final consumption. Rebuilding is complex and challenging because of its multiple temporal, spatial,

[3] A version of this chapter has been published: Khan, A.S., and B. Neis. 2010. The rebuilding imperative in fisheries: Clumsy solutions for wicked problems? *Progress in Oceanography,* 87(1-4): 347-356.

equity, and governance dimensions. In this light, some researchers have argued that fisheries governance is a 'wicked' problem (Jentoft and Chuenpagdee, 2009). Wicked problems are complex, persistent or reoccurring, often hard to detect and to fix, partly because they are linked to broader social issues (Rittel and Weber, 1973).

The rebuilding challenges associated with collapsed fisheries and wicked problems are examined next. The effective resolution of wicked problems requires not only good science and management but also attention to socioeconomic and political considerations (Ludwig *et al.*, 2001; Jentoft and Chuenpagdee, 2009). The very wicked problems most fishery collapses pose for contemporary societies might best be addressed using clumsy solutions. Clumsy solutions are devised with input from all facets of society including the state, the private sector, and civil society. They are designed to cut across the discrete and somewhat incommensurable perspectives that characterize and paralyze efforts to deal with wicked problems (Verweij and Thompson, 2006). These issues are explored in the last section. Clumsy solutions within fisheries are arguably more likely to support social-ecological rebuilding if the question 'rebuilding for whom' and political economy issues are front and centre in the dialogue. The chapter concludes with a summary of lessons learnt towards the rebuilding imperative and areas for further research.

The dynamics and consequences of fisheries degradation

Fisheries include the whole fish production chain, from marine ecosystems, to harvesting activities, processing, marketing, consumption, and the management and governance (Thorpe, *et al.,* 2005). They are social-ecological systems characterized by interactivity across each component of the fish chain and with other biophysical processes (Ommer *et al.,* 2007; Perry *et al.,* 2010a). As presently practiced, commercial overfishing pose profound threats to fish stocks, marine ecosystems, seafood trade, food security, household incomes, as well as the socio-cultural heritage of many fishing communities. According to the Food and Agriculture Organization (FAO), which reports on the status of fish stocks, about 80% of fish stocks were fully exploited and overexploited for the year 2007 (FAO, 2009a). Using FAO statistics, Mullon *et al.* (2005) found that about 25% of fish stocks have lost about 10 per cent of their original biomass in four consecutive years. Further, Worm *et al.* (2009) estimated about 67% of global fish stocks requires rebuilding. These include major commercial species such as blue fin tuna, southern blue whiting, tropical groupers, Georges Bank cod, Atlantic cod, North Sea and Baltic cod, European eel, Northern and southern hake, and orange roughy (FAO, 2009a; Wakeford *et al.,* 2009).

Evidence concerning the negative ecological, economic and social consequences of overfishing is mounting (Wramner *et al.,* 2009). Over-fished stocks entail vulnerability and extinction concerns and thus concerns about loss of biodiversity (Hutchings and Reynolds, 2004). The well-documented patterns within marine fisheries of increased fishing efficiency often masks resource decline until stocks collapse or fail to recover due to poor understanding of fisher behavior (Makinson *et al.,* 1997). Of similar concern is shifting effort from depleted top predators to species lower down the food web (Pauly *et al.,* 1998), with further implications for ecosystem vulnerability (Bundy *et al.,* 2009). These findings amplify biodiversity concerns and raise questions about how overfishing might be affecting the overall productivity of marine ecosystems directly through fishing mortality and indirectly through damage to marine habitats (Halpern *et al*., 2008). Moreover, loss of marine biodiversity has been shown to affect the provision of ecosystem goods and services (Worm *et al.,* 2007).

Fisheries contribute tremendously to food security, livelihoods, trade and the global economy. Fish provide about 20% of the protein intake globally for more than a billion people and comprise a significant proportion of animal protein in human diets in many countries (FAO, 2009a). Total employment in the fishing sector, including fishing dependents, is close to half a billion people worldwide (FAO, 2009a). The value of global exports of fishery products was estimated at 86 billion USD in 2006, an increase of more than 50% since the 1980s (FAO, 2009a). Recent estimates of the contribution of marine fisheries to the global economy range from 225-240 billion USD per year (Dyck and Sumaila, 2010). This includes direct, indirect and induced benefits of goods and services generated by fisheries and seafood trade; from landed value, employment and household income, boat building, infrastructure development, to transportation of seafood across national and international boundaries.

The Millennium Ecosystem Assessment Report (Pauly *et al.,* 2005a) and others (e.g. Ommer *et al.,* 2007) describe the ongoing interactions between marine ecological degradation and social and economic decline within fisheries systems. With few exceptions (Cunningham and Bostock, 2005; Hilborn *et al.*, 2005), existing commercial fisheries are characterized by declining catch-per-unit-effort. This, in turn, is contributing to escalating costs, declining net incomes and related food security concerns (Pauly *et al.,* 2005b, Smith *et al.,* 2010). On a global scale, the World Bank (2004) estimates that about 30 million small-scale fishers have seen declining incomes in recent years. Further, about one third of the global total catch from wild capture marine fisheries, mostly coming from developing countries, is being used in reduction fisheries to produce fish meal and oils for aquaculture and other industries (Alder *et al.,* 2008; FAO, 2009a). These fisheries are contributing to over-harvesting and eroding food security, with relatively little of the wealth and employment they generate trickling down to fishing-dependent communities (Kaczynski and Fluharty, 2002). The rent drain and economic losses in fisheries due to ineffective fisheries governance are estimated to cost approximately 50 billion USD per year globally (World Bank, 2008).

Overfishing is sowing the seeds for poverty, malnutrition, and conflict in some regions (Le Sann, 1998; Garcia and Grainger, 2005). It is also exacerbating income and employment disparities between countries, regions, fleet sectors, as well as across genders (Choo *et al.,* 2004; Neis *et al.,* 2005). In short, there are various ecological, socio-economic and socio-cultural reasons to not simply sustain today's fish stocks but to also rebuild collapsed stocks to healthy levels. This would entail effective management and the establishment of sustainable fishery policies that are not only profitable but also equitable and socially just. This is referred to as the 'rebuilding imperative' in this paper. The evidence for an interest in this rebuilding imperative is growing. Often, however, proponents focus their attention almost exclusively on advocating for reduced fishing effort and better fisheries management. Generally, scientific assessments and insights from fisheries management are thought to be the main inputs required for recovery (Rice *et al*., 2003). Hence, stock recovery is evaluated in relation to conservation reference points, such as those contained in the FAO's Precautionary Approach (FAO, 1995). Two key precautionary reference points often used in recovery programs include: i) an increase in spawning stock biomass to about 40% of historic levels; or, ii) an increase in the mature biomass to about 75% of historic maximum sustainable yield (Caddy and Agnew, 2005).

Rebuilding is linked to recovery of collapsed stocks by an essential transition period that is characterized by decision control rules based on harvesting strategies and stock status (Rosenberg *et al.,* 2006; Wakeford *et al.,* 2009). Rebuilding in this context involves the institutional and decision-making arrangements, spatial scale of implementation, costs and benefits in both the short and long term, and addressing stakeholder concerns for buy-in, compliance and stewardship. Rebuilding also deals with intergenerational concerns (recovery for whom), re-training and adjustment programs, power, as well as distributional and allocation policies. These concerns in addition to food security, the political economy of seafood trade, and effective governance are often overlooked thereby constraining the rebuilding of entire fish chains. Although this distinction is not often made in practice, it underscores successful recovery through a well governed process. The US is one of few countries where there are both recovery plans based on the Endangered Species Act, and fishery rebuilding strategies based on the Magnuson-Stevens Fisheries Conservation and Management Act (Wakeford *et al*., 2009).

To date, and with approaches that focus primarily on stock recovery, about 9% of collapsed and overharvested fish stocks have been rebuilt to historical levels (Worm *et al.,* 2009). Despite some concerted efforts both locally and internationally and persistent calls for management goals that promote recovery, Garcia and Grainger's review (2005 p.33) found that "[t]he present global situation, as during the past five decades, can indeed be characterized as a chronic degenerative trend with occasional, localized acute crises." There could be ecological reasons for this but there are also socio-economic and socio-political reasons such as non-compliance, resistance, the failure to implement recommendations, information needs, technical resources, and lack of stewardship. This suggests that recommendations for conservation and better management policies, while necessary, may not be sufficient for stock recovery and may certainly not be sufficient to protect employment, incomes, food security and coastal communities in the longer term.

Moreover, the recovery literature does not include detailed analyses of the potential economic benefits of reduced overfishing and improved management. Some good examples include Grafton *et al*.'s (2007) analysis of tuna fisheries in the Pacific, and prawns and orange roughy in Australia. The study concludes that conservation promotes access to both larger fish and higher profits. Sumaila and Suatoni (2006) also found that the potential economic benefit from rebuilding 17 overfished stocks in the US was almost three times greater in terms of net present value than the benefits from the present management scenario. The approach in Sumaila and Suatoni (2006) was however partial, and did not account for non-market values such as indirect use value, option value, bequest value and existence value. Incorporating non-market values would provide a more appropriate sense of the potential economic benefits from stock and fishery rebuilding. A recent non-market valuation of two European commercial fisheries, hake and Norwegian lobsters (in the form of option and existence benefits) suggests that societies are willing to pay high premiums for species recovery in the long term (Ojea and Loureiro, 2010). Similar insights into non-market benefits were obtained for six regional aquatic species at risk in Canada (Rudd, 2009). In instances when cost-benefit analyses are undertaken to evaluate the economic benefits of fisheries recovery and rebuilding, they often do not go far enough because of myopic short term policies and conventional discount rates. Sumaila (2004) argues that conventional cost-benefit analyses place less emphasis on future generational needs, suggesting an intergenerational discounting approach is required (Sumaila and Walters, 2005).

These economic arguments can help recruit social and political support for rebuilding, including improved science and management. Such broader approaches are crucial to capture the full cost and benefits in both short and long terms, and have the potential to promote stewardship and public buy-in. These are, however, only one piece of a larger social-ecological approach to fisheries rebuilding; in part because they don't deal explicitly with the governance challenges of rebuilding such as equity, special interests, and stakeholder resistance.

Rebuilding collapsed stocks: Challenges and opportunities

Taking the rebuilding imperative as its point of departure, this section reviews the limited literature on rebuilding initiatives focusing on some of the key factors that have been shown to mediate their success and failure. Information on rebuilding plans and on actual outcomes of such plans for collapsed stocks is often fragmentary and incomplete (Caddy and Agnew, 2005). Generally, however, the likelihood and speed of rebuilding, as well as its consequences for fisheries are mediated by a range of ecological, economic and wider social-political considerations. Ecological factors include the degree and nature of the overfishing that led to the degradation or collapse of the stocks (Hutchings, 2000), life history parameters and density-dependent factors (Walter and Kitchell, 2001), predator-prey relationships and regime shifts (Bundy *et al.,* 2009), as well as other environmental and climate change factors (Brander, 2007). Although all species are vulnerable to overfishing, longer-living bottom dwelling demersal species such as cod and haddock are more susceptible to both economic and biological collapse and require longer rebuilding timeframes and associated higher transaction costs (Dulvy *et al.*, 2003; Caddy and Agnew, 2005). Moreover, potential ecosystem shifts, environmental variability, and the spatial dynamics of fish stocks may affect rebuilding outcomes (Powers, 1996).

Positive environmental change and associated good recruitment, reduction of fishing effort, habitat restoration and proactive governance initiatives can sometimes reduce the risk of stock collapse as in the case of one Newfoundland lobster fishery (Davis *et al.*, 2004). Conversely, early signs of recovery can lead to pressure from stakeholder groups to reopen fisheries prematurely, followed by further decline (Charles, 2002; Rice *et al.*, 2003). These constraints and opportunities can be eroded or enhanced by social, economic and political factors. Further, as stocks decline, technological improvements and spatial shifts in fishing effort often help to sustain catch rates masking resource decline (Hutchings 2000; Neis and Kean, 2003). For such reasons, Walter and Parma (1996) cautioned that effort control measures are by themselves insufficient because technological progress in gear design can increase fishing efficiency. This was evident in the Newfoundland and Labrador cod fisheries between the 1960s and 1990s (Hutchings and Myers, 1995). Data fouling caused by escalating discards of small fish and illegal and unrecorded discarding (Wernerheim and Haedrich, 2007), often invisible to managers but very visible to harvesters, enhance the risk of severe and unanticipated stock collapse and associated delayed rebuilding (Mackinson *et al*., 1997).

Stakeholder resistance to limiting catch quotas, as well as a lack of scientific consensus, played a key role in delaying the rebuilding of the California sardine fishery during the 1960s and 1970s (McEvoy, 1986). Despite warnings about the effects and consequences of overfishing in the 1940s, the fishing industry kept harvesting, encouraged by the scientific notion that pelagic fisheries are abundant and cannot collapse (Ludwig *et al.,* 1993). Further, disagreement between the fishing industry and scientists about factors leading to collapse, whether overfishing or environmental changes, delayed recovery measures (McEvoy, 1986). Eventually, post recovery plans commenced with a public-private partnership between the fishing industry and academia that resulted in the formation of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) in the early 1950s. The sardine fishery went through many management measures such as access restrictions and a moratorium until partial recovery occurred in the late 1990s. These positive developments have been largely attributed to the effectiveness of CalCOFI's scientific initiatives, as well as to the collaboration between the fishing industry and the state agencies that led to both investment in scientific research and to a relatively prolonged moratorium. Scientists finally concluded that while the collapse of the sardine stocks was primarily due to human-induced overfishing, unfavorable environmental factors may have exacerbated the collapse (McEvoy, 1986). For this reason, current managers take variability in environmental factors such as temperatures into account when determining harvest rates and setting precautionary measure[4]. Anderson *et al*. (2008) underscored that commercial fishing can have a huge impact on fish populations, particularly on historical age distribution, contributing to delays in their recovery. Similar concerns were evident in the recovery of the Peruvian anchovetta (Pauly and Tsukayama, 1987) and the Norwegian Spring Spawning Herring (Sandberg, 2010).

Transparency and accountability in decision making processes, especially harvest rules and input from several stakeholders, are important to the success of rebuilding initiatives. Stakeholder inputs into decision-making, however, can mask self-interest that may lead to distrust and undermine collective action (Ostrom, 1990). For instance, Okey (2003) found that the dominance of the fishing industry in some US regional fisheries management councils in the 1990s was sufficiently high as to constitute a conflict of interest situation with strong lobbying powers for higher quotas. More generally in the US, Sutinen (2008) documented lobbying expenditures from fishermen and processor associations, as well as contributions to political parties, to be in excess of a million dollars per annum. Similarly, environmental coalition groups were very proactive in influencing public policy in the wake of the groundfisheries collapse for closed areas in New England (Fogarty and Murawski, 1998). The rebounding of haddock stocks in New England is understood to be partly due to the implementation of legal regulatory instruments to restrict fishing mortality, and related lawsuits by environmental Non Governmental Organizations in the early 1990s (Caddy and Agnew, 2005; Brodziak *et al.*, 2008).

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[4] http://www.nmfs.noaa.gov/fishwatch/species/sardine.htm accessed July 20, 2010.

Factors such as high fishing mortality, poor communication with stakeholder groups, and lack of clarity in the rebuilding measures have been identified as key limiting factors in the success of the Irish Sea cod recovery plan (Kelly *et al.*, 2006). Appropriate choice of policy instruments is fundamental to the success of rebuilding programs as they can provide incentives for participation and in determining management outcomes (Munro, 2010).

Disciplinary boundaries between the natural and social sciences within fisheries management can contribute to general governance issues (Charles, 1995; Verweij *et al.*, 2010). Limited interactions between fishers, scientists and managers, plus inadequate enforcement and surveillance, poor compliance with codes of conduct, and other governance failures can, in turn, produce a downward spiral in the legitimacy of fisheries management initiatives and thereby encourage illegal fishing (Ludwig *et al.*, 1993; Haggan *et al.*, 2007; Pitcher *et al.*, 2009). Illegal, unreported and unregulated (IUU) catch has been estimated at about 11-26 metric tonnes globally, with a total value of about USD10-23 billion dollars annually (Agnew *et al.*, 2009).

Looking beyond the immediate benefits of rebuilding, incentives for stewardship and conservation are good investments as they foster social capital that is relevant for civic engagement, compliance and trust among fishers and other stakeholders (Grafton, 2005). They are probably more likely to be successful if they build on local community or traditional management structures (Jentoft, 2000). Some social scientists have pointed to the tendency for modern fisheries management to erode localized customary management structures and to neglect other worldviews and knowledge systems constraining options for recovery (Neis and Felt 2000; Berkes, 2008; Bavington, 2010).

In many developing countries, despite the conservation and redistributive benefits of 200 mile EEZs, the enactment of the United Nations Convention of the Law of the Sea (UNCLOS) has contributed to the development of unsustainable fisheries practices (FAO, 1993; Greboval, 2002). In Western Africa, for instance, UNCLOS has provided the legislative framework for fisheries agreements administered through central governments and frequently without meaningful input from local fishers and the broader public. These agreements have placed increasing pressure on fish stocks in order to generate export earnings and support debt repayment under structural adjustment programs with negative consequences for food security, livelihoods and resource sustainability (FAO 2001; Kaczynski and Fluharty, 2002).

Overfishing and failed management have been linked to the political economy of an expanding fish trade guided historically by laissez-faire policies and recently through globalized markets (see McEvoy, 1986; Feeny *et al.*, 1990; Neis *et al.,* 2005; Berkes *et al.*, 2006). This suggests that localized rebuilding initiatives are unlikely to be sustainable in the longer term if larger political economy issues are not dealt with. In general, while a wide range of ecological factors can mediate opportunities for rebuilding, the challenges are complex and largely socio-political. These issues are central to the growing literature on fisheries governance to which we now turn.

The rebuilding imperative: A particularly wicked governance problem

Governance means different things to different people, especially in the social sciences where there are multiple disciplinary approaches (Kjaer, 2004). Most would agree, however, that fisheries governance goes beyond government, and is broader than fisheries management (van der Schans, 2001; Gray, 2005; Kooiman *et al.*, 2005). Fisheries management generally deals with national agencies and constitutional acts and uses technical tools such as input or output control measures. Fisheries governance on the other hand includes not only state actors and institutions, but also actors in the private sector, multilaterals, and civil society. It includes formal and informal rules, institutional mechanisms, and both analytical and normative elements. Thus, governance encompasses the "collective, aggregate and integrated process of all these governing actors, which can be more or less organized and routine, rarely harmonious but typically interactive" (Chuenpagdee and Jentoft, 2009 p. 111). According to Charles *et al.* (2009 p. 5), "good governance of fisheries and the marine environment provides the foundation for resilient ecosystems and communities; with governance institutions that are able to adapt to changing economic, social and environmental conditions to remain viable in the long-term." Good governance entails core democratic values including the rule of law, transparency and accountability, management effectiveness, regulatory quality and compliance to rules (see Grafton, 2007; Kaufmann *et al.,* 2007; Mora *et al*., 2009; Pitcher *et al.*, 2009).

Fisheries governance is also about setting values and principles that can guide both governors and non-governors alike in their deliberations (Chuenpagdee and Jentoft, 2009). While there are many schools of thought on governance approaches to resource management (e.g. Ostrom, 1990; Armitage, 2008), they all agree on certain general principles and values. These principles include amongst others: responsibility, participatory and inclusive decision making, effective communication, efficiency, precaution, effectiveness, legitimacy, equity and justice (Berghofer *et al.,* 2008; Constanza *et al.,* 1998; Coward *et al.,* 2000; Gray, 2005; Miles, 1999). In addition, research on institutional performance is scanty and sparse in fisheries despite massive failures in management (Sutinen, 1999; Hilborn *et al.,* 2005; Wakeford *et al.,* 2009). There can be little doubt, however, that effective governance is essential for stock recovery and it is even more essential to rebuilding fisheries and to sustaining them once rebuilt. Governance plays a particularly strong role in fisheries sustainability for at least three reasons (Smith *et al.*, 2010): i) fisheries are coupled social-ecological systems subjected to shocks and uncertainties across jurisdictional management boundaries (Perry *et al.* 2010a); ii) high levels of dependency on these public goods or common pool resources; and, iii) seafood is the most widely traded commodity internationally (FAO, 2009a).

Few authors have identified the governance challenges specifically associated with rebuilding depleted stocks and collapsed fisheries. Recently, the role of fishers, the fishing industry, coastal fishing communities, environmental NGOs, community groups, the media and the general public have been acknowledged as critical sources of input into fisheries planning and decision-making (Bene and Neiland, 2006). However, contemporary fisheries governance is infrequently open to input from a broad range of stakeholders and seldom embodies equity, stewardship, or corporate social responsibility (Bundy *et al.,* 2008).

Ostrom (1990) argues that successful institutional reforms and the devolution of management to stakeholders require defined goals and articulated tasks and responsibilities. To illustrate, the management success of the geoduck clam fishery in British Columbia (Canada) both in terms of economic returns and ecological sustainability stemmed from an institutional partnership implemented through a co-management framework (Khan, 2006). Other examples of effective governance through cooperative or collaborative co-management partnerships can be found in other parts of the world (Pinkerton, 1989; Khan *et al*., 2004; Raakjaer Nielsen *et al*., 2004). Governance is also about how institutions perform and the relationship and interdependence between the state, market and civil societies (Williamson, 1996; Kooiman, 2003; Jentoft, 2005; Ostrom, 2005). From this perspective, coastal communities are sometimes seen as having a vested interest in the long term rebuilding of fish stocks, with legitimate concerns about distributional and intergenerational equity, and local leadership in fostering civic stewardship (Jentoft, 2000; Perry *et al*., 2010b).

Some scholars have argued that fisheries governance (Jentoft and Chuenpagdee, 2009), conservation of endangered species (Ludwig *et al.,* 2001), and climate change (Rayner, 2006) should be regarded as 'wicked' problems. Wicked problems are complex and characterized by deeper problems that go beyond natural sciences to encompass social, economic and political considerations. They can be difficult to perceive; do not "present a clear set of alternative solutions," are associated with contradictory or irreconcilable certitudes, and tend to have distributional and procedural equity implications for stakeholder groups (Rayner, 2006). As a result, wicked problems tend to be persistent or reoccurring in part because they have no technical solutions or fixes (Rittel and Weber, 1973). This is partly because the related policies tend to become wedded to particular conflicting perceptions and 'ways of life' (Rayner, 2006).

If fisheries governance is a wicked problem, rebuilding fisheries is particularly wicked. As argued above, stock rebuilding is not a simple linear process. It is often associated with high levels of uncertainty linked to potential ecosystem effects of overfishing, and to the challenges of managing stock fragments with imperfect knowledge. Problems of legitimacy for science and management linked to the collapse can exacerbate these problems as can institutional inertia to respond (Finlayson, 1994). Prolonged rebuilding and overcapitalization point to the need for industrial adjustment programs which may or may not match rebuilding requirements, and raise questions about who caused the collapse, who will pay for the rebuilding, and who will ultimately benefit. There is a high risk of conflict with outcomes that could be mediated by differences in power between various stakeholder groups. Some authors have argued that these very wicked problems can best be addressed through 'clumsy solutions' (Verweij and Thompson, 2006). These ideas and suggestions are further explored for fisheries rebuilding prospects in the next Section.

The case for clumsy solutions to wicked rebuilding problems

Clumsy solutions seek to recruit all facets of society including the state, the private sector, multilaterals, civil society, communities and individuals to contribute to policy dialogue and collective action (Verweij and Thompson, 2006). In the case of rebuilding fisheries, clumsy approaches would be useful for: i) encouraging efforts for the development of integrative science and knowledge syntheses (Miller *et al*., 2010); ii) supporting efforts to find reforms and governance arrangements to deal with political economy issues (Sutinen, 2010); iii) identifying policy options for sustaining global seafood trade and food security (Smith *et al.,* 2010); and, iv) getting involved in a problem-solving approach that supports institutional innovation and social learning (Jentoft, 2007a; Berghofer *et al.,* 2008). Such reforms and innovations might help address shortfalls and cognitive limitations in decision making at the administrative and institutional level, a concept referred to as 'bounded rationality' (Simon, 1947).

Moreover, Verweij *et al*. (2006 p.1) claim that "successful solutions to pressing social ills tend to consist of creative and flexible combinations of different ways of organizing, perceiving, and justifying social relations". These contending policy perspectives justify, represent and stem from four different ways of organizing social relations: individualism, egalitarianism, hierarchy, and fatalism. 'Clumsy solutions', i.e., policies that creatively combine all these opposing perspectives on what the problems are and how they should be resolved are therefore called for. These four perspectives occur in fisheries debates and are particularly evident in responses to fisheries collapse and the rebuilding challenge. The individualistic perspective underlies rational choice theory and the tragedy of the commons perspective (Hardin, 1968). It informs claims that privatizing fisheries and relying on markets is the best way to enhance stewardship, reduce over-capacity and promote wealth generation from fisheries. From this perspective, incorporating concerns about coastal-dependent fishing communities into marine ecosystem governance reflects a 'rural romantic' mentality that contributes to problems with over-capacity and over-harvesting. It also runs the risk of creating communities that act as social traps where entrepreneurship is discouraged (Hannesson, 2002).

From an egalitarian perspective, fisheries privatization will not necessarily protect the resource from overfishing, as has been demonstrated in many situations (Morgan, 1997). Moreover, there are concerns about placing public goods into the hands of a few, thereby deepening disparities between small-scale and large-scale fisheries, contributing to the erosion of livelihoods at individual and household levels and the destruction of coastal communities (Davis and Wagner, 2006). Those who support the egalitarian perspective emphasize the importance of socio-cultural diversity, alternative knowledge systems, protecting food security and justice and equity for sustainable fisheries (Jentoft, 2000). They draw attention to social and ecological complexity and to the history of local management about fisheries for the potential benefits of the community (Berkes *et al.,* 1989; Wiber *et al.,* 2010). They suggest that community-based resource management can potentially play an integral role in addressing social justice and equity issues; for example, who pays for rebuilding fisheries and who will ultimately benefit when the stocks are recovered (see Charles, 1994).

The hierarchical perspective is evident in the view that fisheries (like other common pool resources) are best protected and managed by technocrats and through planning and management. Left to their own devices, fishers, fishing communities and firms will fish out the resource and dissipate the resource rent (Hannesson, 1996). While there is a need for clear guidelines and for expert engagement with rebuilding fisheries, top-down management structures incur high transaction costs of monitoring and enforcement compared to decentralized cooperative structures (Hanna, 1999). This is due to issues related to levels of compliance, information sharing, trust, social norms and the limited space for stewardship roles by user groups associated with this approach (Ostrom, 1990).

The fatalistic perspective is evident in the growing sense among many that given the fragility of nature, diverse social norms and values, market globalization, and lack of trust amongst stakeholders across the fish chain; there is little point in struggling to reverse the degradation of the world's fisheries. This perspective is frequently seen in gloom and doom scenarios (Garcia and Grainger, 2005; Worm *et al.*, 2007) and the lack of ingenuity in the search for policy options (Homer-Dixon, 2002).

A clumsy solution approach seeks to take advantage of the fact that each of these perspectives include 'elements of wisdom and experience' missing in the others, expressing the way some portion of the populace thinks we should act, and the need for plural view points (Verweij *et al.,* 2006). It does this by looking for ways for all four perspectives and their proponents to be taken into account in experimentation and problem solving while also acknowledging that it may not always be possible to arrive at a workable solution.

Context is important to clumsy solution approaches. For example, research on water management challenges in California found that some of the conditions that are conducive to clumsy solutions included those where: i) there is a pattern of accumulating problems; ii) proponents of all of the different perspectives have more to lose from inaction than from action; iii) there is experience with collaborative arrangements; and, iv) leaders willing to take risks are present and able to act (Lack *et al.,* 2006). There is little doubt that many fisheries collapses, because of the challenges of rebuilding, can lead to a 'pattern of accumulating problems' starting with short-term unemployment, industry viability challenges, scientific consensus on factors of collapse, and management options. These short-term problems are often dealt with using capacity reduction and restructuring programs; but these can be expensive, inefficient, inequitable, and ineffective (Woodrow, 1998; Holland *et al.,* 1999; Clark *et al.*, 2005), and thus inadequate for dealing with prolonged rebuilding challenges.

Using a clumsy solution approach, fishery rebuilding would benefit from knowledge about the entire production chain gathered at multiple spatio-temporal scales, as well as communication of the insights garnered across various stakeholder groups and academic disciplines (St. Martin *et al.,* 2007; FAO, 2009b). For instance, at the level of harvesting and fisheries science, there is a growing literature that acknowledges a degree of incommensurability between fishers' knowledge and science but that also notes the potential benefits of bringing together both kinds of knowledge as inputs into decision-making (van der Schans, 2001; Gray, 2005; Berkes 2008). Such integration could help to reduce miscommunication and deal with knowledge gaps created by spatial and temporal scale mismatches and experiential and organizational boundaries (Haggan *et al.,* 2007; Murray *et al.,* 2008). If levels of conflict can be mitigated and some trust and legitimacy sustained, such integration can also encourage the rapid feedback essential to the context of resource vulnerability that is typical of post-collapse and rebuilding (Neis and Felt, 2000). While such efforts are challenging and entail risks for fishers and scientists and managers; the 'clumsy' products can be very valuable for problem-solving, hypothesis-generation, testing and validation. The different perceptions of the various stakeholder groups can be useful in resolving misunderstandings that arise from miscommunication if there are no fundamental differences in opinion (Berghofer *et al.,* 2008). They also help to reduce the extent to which valuable and indeed essential knowledge is overlooked or lost in the rebuilding process (Neis *et al.,* 1999).

In the Newfoundland and Labrador cod fisheries, as in many others, proponents from some of the different perspectives (individualism, egalitarian, hierarchical and fatalism) did not initially have as much to lose from inaction than from action because of differences in their reliance on cod relative to other species. At present, almost 20 years after the first cod moratoria, many of those who depended on cod have been forced out of the industry (Hamilton and Butler, 2001). Among those remaining, there appears to be a strong perception that rebuilding cod stocks might reduce the abundance and economic benefits available from higher value species (shrimp and crab) which have become the focus for the most powerful industry survivors (see Schrank, 2005). Delayed rebuilding has led to the suggestion that cod should be listed as a species at risk. This was resisted in the past by industry stakeholders, due to livelihood and socioeconomic ramifications (DFO, 2005), and will likely continue to be resisted for some time, despite support from some scientists and conservation groups.

Experience with collaborative initiatives, if weak at the point of collapse, can develop during and in response to dealing with prolonged rebuilding. Collaboration, however, might reflect some perspectives and approaches (e.g. industry or large scale concerns) but exclude others (e.g. coastal community viability). Thus, fishery collapse can threaten or erode collaborative arrangements as well as build upon them. An essential requirement is strong leadership when dealing with prolonged rebuilding, and local capacity building initiatives across generations. This was a key feature that emerged in the Newfoundland Eastport Lobster Protection Initiative (Davis *et al.,* 2004).

Another potentially useful tool for a clumsy solution approach to fisheries rebuilding is adopting a holistic and integrated livelihood framework. Such a framework takes into account the natural, physical, human, financial and social capital necessary to deal with vulnerability in the event of resource depletion, natural disasters, and environmental change (Allison and Ellis, 2001; Allison *et al.,* 2009). An example of this is the Sustainable Fisheries Livelihood Program in small scale fishery communities in West Africa, which was designed to reconcile fisheries conservation and socioeconomic goals. The approach focuses on addressing vulnerability issues through capacity building, diversification, policy processes, rural development and conservation incentives (Allison and Horemans, 2006). Clumsy solutions require broad-based, adaptive approaches and proactive strategies that combine a mix of instruments ranging from legal regulatory instruments to economic incentives, public outreach, international agreements, and stakeholder alliances. They need to be perceived as fair, because they will inevitably require those with different but entrenched interests to give ground.

One of the most challenging issues in fisheries rebuilding is the complex range of tensions revolving around accountability and blame for the collapse, and related perceptions and realities regarding who will pay and who will ultimately benefit from rebuilding. This is called the 'Rebuilding for whom' question. This question has not received the attention it should in research on rebuilding (Ommer *et al.,* 2007). Assigning blame for collapses is by no means straightforward, as we can see from the history of debates about the collapse of California's sardine stocks (McEvoy, 1986) and from those related to the collapse of the northern cod stocks (Hutchings *et al.,* 1997). Proponents of different perspectives will tend to point the finger in different directions – i.e. looking for the burden of proof (Dayton, 1998; Charles, 2002). Similarly, assessing the transaction costs and thus establishing the basis for a fair allocation of those costs across society is a very complex and contested enterprise. It requires good understanding of the resource and ecosystem dynamics, effective information gathering, appropriate decision making processes, monitoring and enforcement, tradeoffs between fleet types, user groups and those employed directly and indirectly, as well as intergenerational concerns. Rebuilding, particularly of long-lived species, requires long-term investment. Because short term costs are tangible and long term benefits are intangible especially as these relate to tenure and stock uncertainty, rebuilding efforts tend to be shortsighted with no interest in future investment among most players (Hanna, 1999; Sutinen, 2010). Moreover, rebuilding challenges often include by-catch restriction concerns that can threaten other fisheries while also driving up the costs of monitoring and fanning debates over who should pay (Caddy and Agnew, 2005).

Fairness is related to equity and justice. Fairness and equity in fisheries can be defined in procedural, distributional and intergenerational terms (Coward *et al.*, 2000; Sumaila, 2004; Sutinen, 2007). Equity issues are among the strongest remaining concerns in the Newfoundland and Labrador cod fishery as participation and employment have been substantially reduced since the groundfisheries collapsed, despite an increase in production value based on harvesting shellfish (Hamilton and Butler, 2001; Shrank, 2005). In the process, wealth and access to the resource have been concentrated in the hands of a declining number of skippers and processors with some fishing communities and many processing workers particularly hard hit (Hamilton and Butler, 2001; Ommer *et al.,* 2007). Similar equity concerns have been raised in the U.S., in association with efforts to rebuild Maine cod, Bering Sea snow crabs and Pacific canary rockfish (Hanna, 2010). For instance, individual transferable quotas (ITQ) can work fairly quickly to constrain access and eliminate excess capacity but raises concern about distributional concerns. In some cases, the implementation of ITQs and effective institutional mechanisms appear to have been associated with success in helping to conserve stocks and protecting the potential for economic returns (Khan, 2006; Griffith, 2008). However, ITQs are not a panacea (Ban *et al.,* 2008); they do not always promote conservation, and tend to rapidly concentrate access to and control over public resources and resource rent in the hands of a few (Clark, 2006; Bromley 2009; Copes and Charles, 2004). These social costs are particularly high where recovery initiatives do not include appropriate social welfare programs and support for diversification into other economic activities. Long-term programs such as education, retraining and alternative livelihood options are necessary to complement short term restructuring measures for successful recovery outcomes (Holland *et al.,* 1999). Who gets to participate in decision making (beyond consultations) regarding rebuilding and who does not, is a key equity issue that can affect buy-in, stewardship, compliance and stakeholder dynamics in both the short and longer terms.

The clumsy solutions literature, while valuable to our understanding of fisheries rebuilding options and stakeholder dynamics, does not pay sufficient attention to the role of power especially during economic restructuring (Sinclair and Ommer, 2006). Power can be defined as the means to act, enforce and influence successful outcomes such as the rebuilding imperative (Jentoft, 2007b). Power can be coercive, as in hierarchical decision-making; disruptive as in protests; corruptive as in the case of seafood mislabeling (Jacquet and Pauly, 2008) and 'under-the-table sales' (Palmer and Sinclair, 1997); and constructive as in collaborative partnerships in problem solving approaches (Canada-Newfoundland and Labrador, 2005). Analyses of rebuilding fisheries need to pay attention to how power relations contribute to and are changed (or not changed) by fisheries collapses and reconcile rebuilding strategies and outcomes (see Gaventa, 2005). Different kinds of power are relevant to understanding the options and opportunities for rebuilding fisheries. These include: legislative power as in public trust doctrines (Turnipseed *et al.*, 2009), citizen power through electoral votes, lobbying power or regulatory capture (Sutinen, 2008), market power (Anderson, 1991), gender power (Neis *et* *al*., 2005), consumer buying power (Brownstein *et al*., 2003), and power related to knowledge, such as in research and development.

Conclusion

For decades, if not centuries in the case of developed countries, most fisheries management policies despite the best available science have been reactive rather than proactive. These shortcomings have encouraged excessive fishing capacity and the steady degradation of marine fish resources (Pauly *et al*., 2002; Clark, 2006). Fishers continue to operate in fisheries that are not managed on precautionary principles and too often within a social-political context that encourages non-compliance. These management approaches have frequently been exported to developing countries where poor technical and financial resources further constrain successful conservation and socioeconomic outcomes. The results have seldom been sustainable, with ongoing problems of global overfishing and catch overages beyond precautionary reference points and stock collapses (Pauly *et al.*, 2002). The ecological, social, economic and political costs of these practices have escalated in recent decades and could, in the absence of major and effective changes, contribute to the collapse of many existing commercial fisheries. These costs are already high and unacceptable, frequently underestimated and disproportionately distributed across classes, genders, countries, regions, and between generations. From local to global scales, what we have called the rebuilding imperative is overwhelming. Unfortunately, little progress has been made on identifying, implementing and rigorously evaluating the effectiveness of rebuilding strategies; not simply with the goal of achieving stock recovery, but also in achieving sustainable and equitable fisheries.

This review of the broader literature on recovery and rebuilding identifies four key governance challenges: (i) distributional and procedural concerns for access and allocation policy measures; (ii) stakeholder resistance or cooperation; (iii) political economy concerns; and, (iv) uncertainties within the ecological, socioeconomic and governing systems. The limited research on the rebuilding of commercial fish stocks suggests these initiatives need to use multiple instruments, ranging from access control measures to seasonal closures, protected areas and habitat protection, stewardship measures, conservation incentives, and international instruments (Caddy and Agnew, 2005; Worm *et al.,* 2009). The success of US rebuilding efforts for Pacific lingcod (*Ophion elongatus*), summer flounder (*Paralichthys dentatus*), king mackerel (*Scomberomorus cavalla*) and Atlantic sea scallop (*Placopecten megallanicus*) has been attributed to the introduction of clear legal mandates and regulatory frameworks, as well as to the presence of appropriate institutional arrangements for both recovery strategies and rebuilding plans (Rosenberg *et al.*, 2006; Wakeford *et al*., 2009). More specifically, rebuilding initiatives in US marine fisheries have shown the importance and need for clear harvest rules, rebuilding timeframes, secured access rights, effective enforcement mechanisms, ameliorating equity concerns, and acquiring stakeholder support (Hanna, 2010).

Rebuilding is essential not only for the ecological resilience of marine ecosystems but also to the wealth, livelihoods, food security and cultural meanings they can generate. During recovery transition, the contemporary and intergenerational costs can be huge- particularly when dealing with the collapse of large commercial fisheries with substantial subsistence components. In these fisheries, the economic challenges associated with high transition costs, exacerbated by short-term employment needs, discounted profits and conservation goals are only some of the many challenges that need to be addressed.

Because of these complexities and broader connections to socioeconomic and policy issues, fisheries governance has been described as a wicked problem. Finding ways to effectively transition from collapsed and poorly managed fisheries to sustainably rebuilt fisheries that promote equity and food security is a particularly wicked problem. Context matters to such efforts, as they are frequently constrained by the social-ecological history of the area and the wider system within which it is embedded, i.e., 'place' and geography matters. Recent literature suggesting reliance on clumsy solutions for wicked problems like climate change and the fisheries rebuilding imperative are worth exploring. Moreover, the high levels of uncertainty and potentially huge social, economic consequences of stock collapse and the often prolonged and disruptive aspects of rebuilding tend to produce particularly polarized perspectives and conflicting viewpoints among stakeholders. Each perspective has elements of wisdom and experience within it, but each is also lacking in critical ways. The clumsy solution option tries to arrive at solutions that tap into the wisdom and experience in each and to bring together the stakeholders associated with each perspective. Clumsy solutions within fisheries are partly constrained by power dynamics, which can make inaction more attractive than action for some groups. Power brokerage through social and economic networks may also marginalize options and creates potential rifts and social dilemmas as argued by Gaventa (2005).

Frequently, one or two perspectives, such as the individualistic or hierarchical dominate decision-making, skewing the distribution of the costs and benefits of rebuilding across groups and potentially jeopardizing the success of rebuilding initiatives. Where problems are accumulating and other conditions conducive to clumsy solutions exist, effective leadership might be crucial to create the synergies and dialogue essential to move forward. Our analysis of the literature on fisheries rebuilding suggests that future research needs to explore what types of governing models and instruments work best, within which institutional frameworks, geopolitical contexts, and at what spatial and temporal scales. Clumsy solutions for rebuilding fisheries need to incorporate attention not only to fish stocks but also to the human dimension of the production chain such as markets and seafood trade (Wessells *et al.,* 2001), institutions that span from local to global scales (Jentoft, 2005; Sumaila *et al*., 2007), and power (Gaventa, 2005). These are useful tools to potentially enhance overall governance, sustainability, and food security concerns. Clumsy solutions need to address procedural, distributional and intergenerational equity issues through incentives for entrepreneurship, diversification, as well as empowerment through capacity building. While no panacea, clumsy solutions are a potentially valuable tool in the limited toolbox available to address the fisheries rebuilding imperative.

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Chapter III: A Fish Chain Analysis of Wicked Rebuilding Problems: Pre-harvest and Harvest Stages of the Northern Gulf Cod Fisheries

Introduction[5]

Around the world, many fisheries have collapsed and several others, particularly groundfish stocks and large pelagics, are experiencing the impacts of overexploitation (FAO 2010). To date, most institutional responses to collapsed stocks such as Atlantic cod (*Gadus morhua*) have sought to achieve the recovery imperative through reduced fishing pressure, industry restructuring, and rationalization measures (Rice *et al.,* 2003; Ruseski 2008; Cliff and Team 2011). These recovery attempts are largely state-driven and guided by a single-species model of scientific enquiry that is uncertain due largely to multispecies interactions and environmental changes (Charles 1997; Savenkoff *et al.,* 2007). Because of institutional rigidities and poor communication (Hutchings *et al.,* 1997); these efforts have had limited success and are often contested by stakeholder groups (Schrank 2005; Murray *et al.,* 2005).

We argue for a rebuilding imperative as the recovery approach is inadequate in dealing with broader human dimension and institutional interlinkages. As mentioned in previous chapters, rebuilding differs from recovery in that the former strives to address socioeconomic and sociopolitical challenges, in addition to resource conservation concerns. We conceptualized fisheries collapse and rebuilding as a 'wicked problem' because of the complexity of the ecological and social systems, the governing system, and the interactions between them (Jentoft and Chuenpagdee 2009). Further, attaining multiple fisheries objectives for collapsed stocks is

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complex, as it involves tradeoffs between short- and long-term considerations (Worm *et al.,* 2009). In fact, neither the reasons leading to fisheries collapse, nor the target reference points or strategies for ecosystem recovery are easily agreed upon (Shelton and Rice 2002). These challenges involve huge financial and institutional investments, and in the absence of a participatory process and effective governing institutions, often result in recovery failure (Wakeford *et al.,* 2009; Murawski 2011).

As discussed in Chapter I and II, the dilemmas raised by trying to achieve multiple and sometimes conflicting objectives in resource governance necessitate a move towards human-nature scholarship and coupled marine social-ecological systems (Folke *et al.,* 2005; Ommer *et al.,* 2010; Perry *et al*., 2011). Such rebuilding approaches pay attention to system interactions, transitional management initiatives (Shove and Walker 2007; Fisher-Kowalski and Rotmans 2009), drivers and feedback mechanisms for sustaining both the resource and human welfare (Osterblom *et al.,* 2010, 2011). We concur with this perspective, which also aligns well with the interactive governance theory (Kooiman *et al*., 2005) drawn upon in this study. Specifically, interactive governance theory posits that fisheries are a relationship between natural and social systems that are highly interconnected through the pre-harvest, harvest and post-harvest stages of the fish production chain or 'fish chain' (Bavinck *et al.,* 2005). The more diverse, complex, and dynamic the fisheries systems and production stages are, the less governable they are likely to be, unless the governing system is highly capable and appropriate institutional mechanisms exist (Chuenpagdee and Jentoft 2009). Concerns around governing capacity in fisheries, referred to as governability (Kooiman and Chuenpagdee 2005) are central to rebuilding, as they provide the foundation for capacity building and institutional innovation at various spatial scales.

This chapter introduces the Northern Gulf cod case study and the analytical framework for a fish chain approach that informs this and subsequent chapters. Northern Gulf cod (*Gadus morhua*) fisheries collapsed in the Gulf of St. Lawrence in the early 1990s, resulting to two complete moratoria imposed between 1994 and 1996, and again in 2003. In addition in these management measures, there was a reduction in total allowable catches (TAC) in subsequent years, along several restructuring and adjustment programs in fleet and fishing capacity. The impact of the stock collapse has consequences along the entire fish chain, especially on livelihoods, processing sectors, marketing and retail, fishing dependent coastal communities, organizational structures, and decision-making approaches.

The collapses of the Northern Gulf cod fisheries and other groundfish stocks in Atlantic Canada have been attributed to many factors. Paramount amongst these are overfishing beyond biological reference points, unsustainable fishing practices by dragger fleets, non-compliance and 'under the table sales' (Sinclair and Palmer 1997), stock assessment failure and data fouling (Finlayson, 1994), ineffective fisheries management, environmental changes, as well as institutional rigidities (Rice *et al.*, 2003; Hamilton *et al.,* 2004; Ommer *et al.,* 2009).

The challenges for fisheries rebuilding have implications beyond fish stocks and marine ecosystems, to livelihood issues, equity and social justice, community empowerment, marketing, and institutional mechanisms. In this chapter, we first provide background information on the case study region in the pre- and post-collapse periods, and demonstrate how rebuilding the Northern Gulf cod fishery is a wicked problem. Using a 'fish chain' framework, the chapter examines rebuilding challenges and opportunities focusing on the pre-harvest and harvest stages. Findings on the comparative fish chain analysis of the Northern Gulf cod fishery are presented, underscoring the scientific, socioeconomic, and institutional ramifications of resource collapse and rebuilding prospects. This is followed by a discussion and policy implications for rebuilding.

Northern Gulf cod case study

The pre- and post-collapse context

Northern Gulf cod fisheries in the Northwest Atlantic Fisheries Management Organization (NAFO) region 4RS3Pn collapsed in the early 1990s in the Gulf of St. Lawrence, bordering Quebec, and Newfoundland (Figure 1). The cod stocks are one of ten stocks in eastern Canada, with an annual migration between southeastern Quebec and southwestern Newfoundland in both the spring and summer months (Methot *et al.,* 2005). In the spring, the stocks undergo a spawning migration from Quebec (Division 4S) and western Newfoundland (Division 4R) towards Bay St. George and the Port au Port Peninsula (Division 3Pn) as shown in Figure 1. In the summer, as the waters get warmer and cod prey such as capelin (*Mollutus villosus*) increases in abundance, the stocks take a northern feeding migration towards 4R and 4S. In the winter, the stocks are found in the 3Pn region at depths of more than 366 meters (DFO 2010a).

Although these stocks are considered isolated, there is scientific evidence that they occasionally mix with other NAFO regions including the Strait of Belle Isle around 3K, the Burgeo Bank region in 3Ps, and the southwest part of the gulf region around 4TVn (Yvelin *et al.,* 2005). As will be later discussed, the stock migratory behavior contributes to making rebuilding a wicked problem, in part because of scientific uncertainty of stock structure and other biophysical factors such as ice over (Frechet, 1990), and unregulated fishing activities in this management zone and adjacent ones.

The Northern Gulf cod fishery falls under various jurisdictional management structures, including the federal Department of Fisheries and Oceans (DFO) for harvesting regulations and resource conservation and various provincial departments in Quebec and Newfoundland and Labrador for processing and marketing operations.

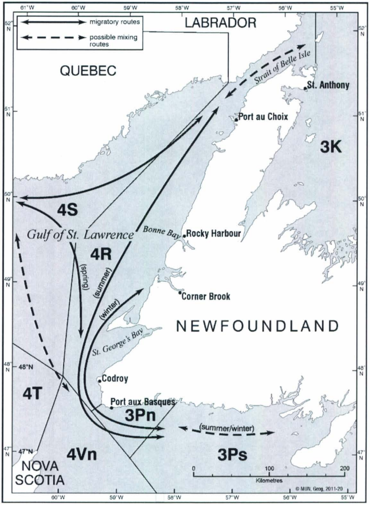

Figure 1: Northern Gulf cod migratory routes in NAFO region 4RS3Pn (adapted from Yvelin *et al.,* 2005 and Murray *et al.,* 2008).

The Fisheries Act (1867) is the key legislature that governs the management of marine fishery resources in Canada. According to the Supreme Court of Canada in 1997, it is the duty of the

Ministers of DFO to manage, conserve, and develop the fisheries on behalf of all Canadians in the public interests (Hutchings 2010; OAG 2011). DFO is the main federal agency responsible for developing and implementing fisheries management plans. In 2010, DFO had a budget of nearly 2 billion CAD with about 11,000 people in seven regions across the country, namely the Pacific, Maritimes, Newfoundland and Labrador, Quebec, Central and Arctic, Gulf region, and the National Capital Region[6]. New institutional mandates and policy initiatives have been enacted by the federal government after failed attempts to modify the *Fisheries Act*. Notable new legal instruments include the *Oceans Act* in 1997 and the *Species at Risk Act* (SARA) in 2003. According the Office of the Auditor General (2011), "we concluded [in 1999] that the [Fisheries] Act did not include clear objectives that reflected the social, economic, and ecological nature of sustainable fisheries (OAG, 2011: p23). The two Acts are to accommodate policy shortcomings in the *Fisheries Act* for broader stakeholder involvement in marine stewardship initiatives, ecosystem approach, and integrated management.

In Newfoundland and Labrador (NL), the Department of Fisheries and Aquaculture (DFA) is in charge of processing and marketing policies. Similarly, the Ministry of Agriculture, Fisheries and Food in Quebec is responsible for fish processing and food. Quota allocation for cod stocks in the gulf region reflects historic sharing mechanisms of about 75% to NL and 25% to Quebec (GNPFT 2006). In NL (especially the 4R3Pn region), both the harvesting and processing sectors are unionized, notably the Food, Fish and Allied Workers Union (FFAW) represents fish harvesters and plant processing workers; and the Association of Seafood Producers (ASP) and the Seafood Producers of Newfoundland and Labrador (SPNL) for plant owners and processors.

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6 http://www.ottawacitizen.com/business/Strategic+review+Fisheries+Oceans+affect+employees/5844597/story.html last accessed December 13th 2011.

During the 1970s and 1980s in the pre-collapse period, fisheries management was based on licensing, total allowable catch (TAC) quotas, individual allowable vessel quotas, and vessel and gear restrictions. Vessel length categories range from less than 25' to more than 100' long, with gross registered tonnages (GRT) of about 15 for small vessels, 15 to 60 for medium vessels, and greater than 100 for larger trawlers. The smaller vessels are mostly inshore and nearshore fleets (less than 25' and from 25'to 34') using fixed gear such as long lines and gill nets. The larger vessels are in the midshore (35' to 64') and offshore fleet categories (greater than 65'), mostly utilizing mobile gear and with enterprise allocations (a form of individual quotas allocated to vessels). Since the 1970s and 1980s, there has been a drastic decline in the use of large trawlers with GRT exceeding 1000 especially groundfish otter trawlers (Pinforn 1988). Before the collapse of the fishery, both foreign and local vessels were prosecuting the fishery resources using various fishing fleets.

Early signs about stock decline were raised by inshore fish harvesters in the late 1980s (Palmer and Sinclair 1997), but went unheeded till the early 1990s when the stocks were pronounced collapsed by DFO. Fisheries management measures were revised and updated to take into consideration the stock collapse: starting with two complete moratoria, one from 1994 to 1996, and a brief one in 2003. In between the two moratoria and starting from1997, the Northern Gulf cod fishery has been managed on a small commercial and recreational fishery basis. The TACs have been reduced to about 90% historical levels, in addition to implementing fleet restructuring and income adjustment programs. The TACs are limited to less than 9,000 tonnes for the stocks to rebuild, and have fluctuated from 3,500 tonnes to 7,000 tonnes in the years from 1997 to 2010 depending on stock recruitment and growth (DFO 2010a). Foreign fleets and offshore mobile fleets have not been permitted to take part in the current fishery till the

TACs rebound beyond 9,000 tonnes. New policy measures have been implemented including the establishment of dockside monitoring and on-board surveillance mechanisms (DFO 2010a). The total number of licenses issued in 2009 was 915 and 905 in Quebec and Newfoundland respectively, with 179 active in Quebec and 720 active in Newfoundland. All the active licenses are for boats less than 65' long using fixed gears in inshore regions, with none of the larger mobile boats greater than 65' been operational at the moment (DFO 2010b).

Several task forces on restructuring and adjustments have been established in response to the collapse of these regional cod fisheries in Atlantic Canada, beginning with the federal Task Force on Incomes and Adjustments in the Atlantic Fishery in 1993, and culminating to federal-provincial Cod Recovery Action Teams in 2003 (Canada-Newfoundland and Labrador 2005, 2006; Canada-Quebec 2005). The adjustment programs and restructuring initiatives include the Atlantic Fisheries Adjustment Program, Northern Cod Compensation Adjustment and Recovery Program, Atlantic Groundfish Adjustment Program, the Atlantic Groundfish Strategy, the Canada-Newfoundland Agreement on Economic Renewal, the Canadian Fisheries Adjustment and Recovery Plan, the Short-term Adjustment Initiative (for the Gulf region only) and the Temporary Fishers' Income Program (ACOA 2004). The cost of the restructuring initiatives and adjustment programs implemented in eastern Canada from early 1990s to mid 2005 has been estimated at 4.0 billion CAD (Rice *et al.,* 2003; Ruseski 2008). These programs were terminated in 2005 due to several reasons; i) the programs were very costly for the federal government in the long-term; ii) the demand for more social assistance was escalating in the absence of other options such as transitional livelihoods; and iii) the programs did not fully contribute to addressing the social needs of the stakeholders mostly affected (Rice *et al*., 2003; Best 2009).

Regional task forces were also established to initiate policy discussions and community engagement amongst stakeholders, such as the Great Northern Peninsula Fisheries Task Force in western Newfoundland (GNPFT 2006). A Provincial Act for professionalization of the harvesting sector was put in place in 1997 to limit access and to provide safety and other types of training for fish harvesters. This was primarily based on the recommendations from the federal Task Force on Incomes and Adjustments Reports (Cashin, 1993; GTA Consultants Inc, 1993). Similar policy measures were recommended for the processing sector with the intention of reducing capacity, including limits on new licenses for primary processing, placing a freeze on secondary processing licenses, and various divestiture programs to downsize the industry and reduce on government support (DFO 1996).

Despite these legislative policy changes and recovery efforts to date, scientific stock assessments show that Northern Gulf cod stocks are below conservation limit reference points, meaning that rebuilding has stalled (Rice *et al.*, 2003; DFO 2010a). There are also concerns about how marine food webs may have been altered, thus affecting biodiversity and recovery timeframes (Savenkoff *et al.,* 2007; Morissette *et al.,* 2009). These related changes in the ecosystem, the current poor status of the cod stocks, and the uncertain outcomes of the restructuring programs have had serious implications for livelihoods and for the regional economies within which the fishing communities are embedded (Ommer *et al.,* 2007).

The NAFO region 4RS3pn, although under one regional management jurisdiction is culturally diverse and heterogeneous, based in part on historical settlement patterns. The 4S region lies in Quebec and also hosts DFO's regional science branch (Maurice Lamontagne Institute) and regional management offices for the NAFO gulf region (Mont Joli and Moncton respectively). The 4R3Pn region in western Newfoundland is the main case study region, which is equally diverse, stemming from historical settlement patterns, social norms, and diverse biophysical environments. Settlement in western Newfoundland in the 4R region dates back to 1000 AD, to early European settlements by the Vikings at L'Anse aux Meadows; and in the early 1900s to the 'French Shore' settlements (Sinclair 1985). This is a region where French fishers under the Treaty of Utrecht (1713) were allowed to process their fish centered around Port au Choix region till 1904. The fishery in this region has also evolved within the past century from fixed gears using traps and lines to more sophisticated mobile dragger fleets (Sinclair 1985); with conflicts amongst fishers as well as with processors and fish merchants (Macdonald 1985; Felt and Sinclair 1995). Despite these conflicts and protests, this region has a history of community development, with one of the earliest community development corporations (Sinclair and Neis 2008), and have been involved with regional initiatives such as the Great Northern Peninsula Fisheries Task Force (GNPFT 2006).

The coastal communities in western Newfoundland in the 4R region are considered to be among the most fishery dependent in Canada (Hamilton and Butler 2001). They historically depended on the groundfish resources, and since the collapse, there have been demographic changes through an aging adult population and youth outmigration (Felt and Sinclair 1995; Hamilton and Butler 2001). Also, the socioeconomic impact in terms of the loss of livelihoods has been devastating in this region, with approximately 50% reduction in employment in both the harvesting and processing sectors (GNPFT 2006). An estimated 6.3 million CAD was lost to the economy of the Red Ochre Regional Economic Development Board (RORDB) in the Great Northern Peninsula in the western Newfoundland due to the second moratoria alone. The RORDB is one of twenty regional economic development boards (REDBs) set up in the province to promote alternative livelihoods in the early 1990s (ACOA 1995).

Unlike the 4R region that is highly dependent on fisheries and with little economic options, the 3Pn region has been a transportation hub and trade routes for merchants not only to mainland, but also to some New England states[7]. This unique feature of the Channel- Port aux Basque region in the 3Pn region was spurred by the Trans-Newfoundland railway in the 1890s and a ferry service across to Nova Scotia. The fishery in this region also dates back to the 1500s when Basques whalers frequented this region and became a prominent fishing region because of its ice free harbor (see Frechet 1990). The region also gained strong French influence because of the Treaty of Utrecht of 1713. During the 'glory days' of high landings by the dragger fleets in the 1970s to 1980s (Palmer and Sinclair 1997), this region saw a lot of fishing activity, as most of the draggers from the 4R especially Port Saunders and Port au Choix will conduct winter fishing activities in this region. This led to several conflicts between fixed gear and mobile gear fleets, which resulted to a buffer zone in the late 1980s that excluded dragger fleets in waters less than 100 fathoms deep, the '100 fathom edge rule' (Palmer 1992). Other conflicts were evident in the processing sector, with the trucking of fish from the southwest coast to the northeast coast and other parts by processors, resulting to employment and equity concerns (Palmer 1992).

In the post collapse periods in the 1990s and 2000s, there have been several stewardship initiatives by local inshore fishers and community organizations in the 3Pn region. First, a major breeding and spawning ground was identified in St. Georges Bay by local fishers, which was officially declared a seasonal closure in 2002 (DFO 2010a). Second, local inshore fishers recommended the adoption of a strictly hook and line fishing policy since the early 1990s, which was approved by DFO and is currently in effect. Third, in collaboration with community partners such as the town of Burnt Island, Service Canada, The harbor Authority, and Fisheries

[7] http://www.portauxbasques.ca/tourism/history.php last accessed December 13th 2011.

Committees; a hook and line museum was created in Burnt Island in 2003 to showcase fishing culture and local stewardship, and to also promote eco-tourism in the region[8].

As these bottom up stewardship garnered recognition, in addition to collaborative efforts to promote stick recovery, there is a gradual shift in target species from groundfisheries to shellfisheries, mainly Northern shrimp (*Pandalus borealis*) and snow crab (*Chionoecetes opilio*) in the 4R region. These, together with more intensive lobster fisheries, a seal hunt and some small pelagic fisheries have provided livelihoods for those remaining in the fishery in the gulf region as a whole. According to the 2010 Provincial Seafood Industry Review, shellfisheries comprised nearly 60% of landings by volume and approximately 84% of the total landed value in the province as a whole. However, this higher production value has not resulted in an increase in livelihood opportunities due to lower landed volumes and limited value-addition. This is partly because lobsters are largely exported live and the mechanized nature of shellfish processing methods (Schrank 2005).

We build upon the argument in Chapters I and II that rebuilding fisheries is a wicked problem because of the complex socioeconomics and sociopolitical linkages. In the next section, we examine the wicked attributes of the Northern Gulf cod fisheries, in order to identify key rebuilding challenges and to explore institutional mechanisms for successful rebuilding.

Wicked rebuilding challenges

This section analyzes the wicked rebuilding problems associated primarily with three key changes: policy measures, rebuilding programs, and institutional arrangements prior to and after the collapse of the Northern Gulf cod fisheries. The analysis focuses on changes happening in the pre-harvest and the harvest stages of the fish chain.

[8] http://burntislandsnl.ca/hookcenter.html last accessed December 13th 2011.

In the case of the Northern Gulf collapse, stock abundance and rebuilding efforts have been highly contested. This relates to the multispecies nature of the fisheries, where population size for some collapsed species may create by-catch concerns for non-threatened species; and associated problems with high grading and discarding. Moreover, the collapse of the groundfisheries may affect predator-prey relationships amongst fish groups leading to regime shift and longer recovery timeframes (Morissette *et al.,* 2009). Also, previous moratoria on collapsed cod stocks have created loss in employment for many households (GNPFT 2006; DFO 2010a). Changes in target species from groundfisheries to shellfisheries may also affect stakeholder buy-in on quota reductions for stocks to rebuild to sustainable levels (Hamilton *et al.,* 2004; DFO 2010a).

Because the cause of the collapse cannot be attributed to any one reason, the choice of policy instruments for fisheries rebuilding raise doubts and concerns with stakeholders about what is effective, at what spatial scales, and how legitimate the proposed policies are, as well as concerns about agenda setting, and social and environmental justice (Coward *et al.,* 2000). Fisheries rebuilding is also tied in with community livelihood issues, as quota reductions and plant closures affect community and regional economic development, especially in the absence of effective institutions that pay attention to equitable allocation and stakeholder needs (as discussed in Chapter V). Because of the centrality of the rebuilding imperative, there are often trade-offs between short-term loss and long-term benefits of rebuilding, especially with the 'rebuilding for whom' question (Ommer *et al.,* 2007). Often, the transition from overfished to rebuilt status call for a reduction in the exploitation rate for stock recovery, relying on biological reference points such as Maximum Sustainable Yield (Worm *et al.,* 2009). This transitional period is also very challenging to manage, as compliance to decision control rules and harvest strategies, are necessary but not sufficient for effective rebuilding. Rather, evidence from Europe, North America and Oceania suggests that much depends on dealing with the livelihood and institutional issues (Wakeford *et al.,* 2009). Evidence also suggests that reductions in exploitation rates and TACs have ramifications on distributional equity, employment, revenue, and uncertainties regarding cost and benefits in the long term as demonstrated in the rebuilding efforts for cod stocks in Canada and the US (Ommer *et al.*, 2009; Hanna 2010). These socioeconomic concerns make rebuilding highly contested and challenging; as issues of power, accountability, blame, social and economic impact of restructuring causes persistent conflicts. As argued in Chapter II, these socioeconomic and sociopolitical concerns make rebuilding a very wicked problem, as stakeholders have the capacity to influence rebuilding outcomes. Scientific uncertainties in stock status and trends have led to protests amongst stakeholders as evident with the California sardine rebuilding (McEvoy 1986). Lessons from the Gulf of Main cod rebuilding have also shown how various forms of contestation about scientific uncertainty, distributional equity, and various stakeholder concerns can lead to litigation, congressional intervention, public commentary, and subsequent amendments to the regional fisheries management plan (NEFMC 2008; Hanna 2010). Controversies resulting from these socioeconomic impacts have also led to federal intervention estimated at $16 million USD to assist the fishing industry in its transition to deal with these concerns (NOAA 2009).

Livelihood transitional concerns and stakeholder conflicts are not the only notable challenges about wicked rebuilding problems. Scientific uncertainty and potential regime shifts bring in transformation concerns regarding appropriate institutional mechanisms towards ecosystem approaches and adaptive governing capacity (Gelcich *et al.,* 2010; Osterblom *et al.,* 2010). In response to implementing successful ecosystem approaches and considering stakeholder values (see Wilhere 2008), the National Oceanographic and Atmospheric Administration issued ten key requirements in the case of the US ocean policy, relevant towards rebuilding efforts[9]. These include: public engagement, strong leadership, communication among stakeholders; incentives for collaboration, cross-boundary facilitators, clear measurable goals, science-based decisions, legislative mandates, adaptive management, and sustainable funding.

Wicked problems also entail making hard choices, sometimes between small-scale versus large-scale fisheries, restructuring initiatives that are both equitable and socially just, and the choice of local versus international seafood marketing (as discussed in Chapter IV). Moreover, fisheries collapse as a wicked problem can be symptoms of larger problems beyond fisheries management. For instance, they can be related to economic globalization, global environmental change, and cultural shifts in values. These multifaceted problems are relevant to understanding wicked rebuilding challenges for Northern Gulf cod fisheries as they point to the need for holistic approaches that are social-ecological and underscore the rebuilding imperative.

With this in mind, this chapter specifically seeks to address two questions: How have changes in Northern Gulf cod fisheries in the pre-harvest and harvest stages of the fish chain affected rebuilding prospects? And what alternative institutional mechanisms could promote social-ecological rebuilding of Northern Gulf cod fisheries?

Methods

Two key steps were undertaken. First, an extensive review of fisheries recovery efforts was conducted, covering existing and historical documents, policy and legal statutes, statistical information, scientific research, and government commissioned reports. An analysis of these information sources was performed to identify ecological constraints towards cod rebuilding,

[9] http://www.csc.noaa.gov/magazine/2011/06/article2.html last accessed December 15th 2011.

policy changes that promote or exacerbate rebuilding, community concerns on governing options, and institutional arrangements for economic viability.

Second, semi-structured interviews were conducted with fifty key informants from diverse stakeholders groups along the entire fish chain as shown in Figure 2. The interview themes for the pre-harvest and harvest stages of the fish chain center around the following: i) status and prospects of restored fisheries ecosystems; ii) scientific and management efforts; (iii) socio-economic and livelihood concerns; iv) stewardship towards rebuilding; and (v) institutional and policy initiatives for rebuilding. Although the post-harvest stage and the governing interactions are briefly touched upon, they are fully discussed in Chapters VI and V, respectively.

The key informants included seven scientists and fisheries managers, twelve resource harvesters, eight entrepreneurs in the processing and retail sectors as well as plant workers, seven municipal and community planners, ten bureaucrats and policy makers, six research analysts from consulting, academia, and the media. The key informants were identified based on background research and through snow-ball sampling techniques. The in-person interviews were conducted throughout northwestern and southern Newfoundland in the 4R3Pn gulf region in the fall of 2009 mostly with fishers, processors, community planners, and municipal leaders. More interviews with fisheries scientists, managers and policy makers in Corner Brook and St. John's (NL), Mont Joli (Quebec), and Ottawa (Ontario) were undertaken until the spring of 2010 through face-to-face interviews and sometimes through telephone interviews.

The interview transcripts and the policy documents were analyzed using both diagnostic and prescriptive approaches. The diagnostic analysis centers on identifying rebuilding challenges that stem from two of the three production changes, i.e., the pre-harvest and harvest stages of the fish chain. The prescriptive analysis is used to identify opportunities and provide policy recommendations for rebuilding prospects that consider livelihoods security and coastal community viability.

The fish chain analytical framework

If rebuilding Northern Gulf cod fisheries is truly a wicked problem, then the traditional hierarchical and technical management approach is insufficient to address these multifaceted social, economic, and jurisdictional challenges. "For wicked problems, a governance approach is needed, whereas management is for what Rittel and Webber call tame problems" (Jentoft and Chuenpagdee 2009: 554). Such governance approaches collectively encompass contributions from the state, civil society, and industry in decision-making and shared stewardship (Gray 2005; Kooiman *et al*., 2005). Moreover, issues of equity, community viability, compliance, by-catch and discards and stewardship are best addressed through an 'argumentative process' of interactive learning and stakeholder buy-in, which is another key aspect of governance (Jentoft and Chuenpagdee 2009). These considerations provide opportunities to identify contextual factors that influence successful outcomes and governing options.

The fish chain is an analytical and holistic framework that examines fisheries as coupled social-ecological systems and that considers rebuilding problems as extending from 'oceans to plate'. The conceptual framework is drawn from the interactive governance theory (Kooiman *et al.,* 2005), which posits that fisheries are a relationship between natural and social systems interconnected through three production stages: the pre-harvest, harvest, and post-harvest stages, as shown in Figure 2.

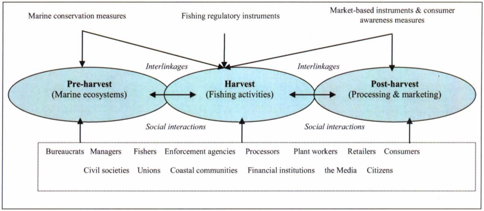

Figure 2: The fish chain framework includes vertical and horizontal linkages between the three production stages (ovals), policy instruments (texts on the top) and stakeholder groups (texts in the bottom box). Diagram adapted from Mikalsen and Jentoft (2001) and Bavinck *et al.* (2005).

At the pre-harvest stage, the focus is on understanding the marine environment, including fisheries biology, life history migratory patterns, habitats, and ecosystems. Both bio-physical and ecological factors and processes such as nutrient flow, temperature changes, currents, upwelling, and predator-prey relationships are forefront in this stage. The harvest stage includes fish capture and harvesting strategies, fishing fleets and fishing operations, by-catch and discards, dockside value, as well as cost and earnings of fish harvesters. The post-harvest is the final stage in the fish chain, concerning with various types of processing activities, coastal community inter-linkages and labour markets, quality control, labeling standards, marketing strategies, and distribution channels that spans local boundaries and across global markets.

The various production stages do not operate in isolation (Johnson *et al.,* 2005). They are interconnected through formal and informal institutions as well as social networks and economic organizations at multiple scales (Perry and Ommer 2003; Hartley 2010). Moreover, a mixture of policy instruments is employed to govern the fish chain ranging, from conservation measures, fishing regulations, stewardship incentives, international agreements, processing standards, and marketing strategies. As shown in Figure 2, these instruments interact with ecosystems as well as actors through socio-political arrangements that mediate governing outcomes. The stakeholders along the chain are not fixed in one stage; they are interactive and may be dominant in one or more production stages with varying levels of influence and power (Mikalsen and Jentoft, 2001).

Spanning multiple spatial and temporal scales, fish chains are highly diverse, complex, and dynamic (Bavinck *et al.,* 2005). As illustrated in Figure 2, the analytical framework is useful for understanding rebuilding challenges by identifying key stakeholders and their networks, policy instruments, contextual drivers, and governing interactions that may affect rebuilding prospects along any of the production stages. Also a comparison of the cod fish chains pre- and post-collapse provide opportunities to understand how changes (in marine ecosystems, policy instruments, restructuring programs) affect cod fisheries rebuilding prospects and the viability of fishing dependent coastal communities.

Findings on the comparative cod fish chain for the pre-harvest and harvest stages

The findings on the comparative fish chain analysis in the pre- and post-collapse periods are presented in three sections based on key emerging themes in the pre-harvest and harvest stages:

a) scope of science and policy at the pre-harvest stage and consequences for stalled rebuilding;

b) changes in harvesting policies and their impacts on transitional livelihoods and stewardship; and

c) institutional inertia, policy disconnects, and scale mismatches.

Scope of science and policy and consequences for stalled rebuilding

The study findings revealed that the scope of science and policy-decision making towards rebuilding is generally narrow, and thus has consequences for ecosystems restoration, transitional livelihood programs, and community viability. There have been changes in marine ecosystem structure, such as shifts in capelin predation rate and energy flow, from groundfish predation in the pre-collapse period to cetaceans and seals in the post-collapse period (Savenkoff *et al.*, 2007). These changes have implications on cod growth, recovery timeframe, and harvest rates for fishing activities (Bundy *et al.*, 2009). Moreover, the lack of harvest decision rules for setting rebuilding targets, and the continuing reliance on single species approach that ignores ecosystem interactions, environmental changes, along with a high level of livelihood dependency of fishers on marine resources, all contribute to inhibiting effective rebuilding. These, and the implication for stewardship and livelihoods, are further discussed below.

Weakening role of science in policy decision-making

Key informants, in particular research scientists from government agencies and academia, identified the current shortage of research funding and technical resources for undertaking research on assessing resource status and ecosystems changes. The lack of technical resources and staff further constrains the ability of scientists to play an appropriate role in fisheries management. As exemplified by one key informant, a research scientist, decisions about fisheries harvest rates, like the setting of the TACs, are no longer based on science, but have, instead, become more political and ad-hoc:

> The role of science has weakened [starting] in the 1960s and 1970s, not just in fisheries. I think there was a movement that said that things would be better with scientific verification. I still believe that, [but] government doesn't. Decision makers had to address

why they made their decisions based on science. The link became weaker between science and decision making, maybe because of society. We used to have decision rules in the 1970s and 1980s for setting the TACs based on the harvest rates. It was based on $F_{0.1}$– fixed percentage of the biomass…That strategy worked quite well, but they abandoned it [in the 1970s] through DFO and NAFO, they went to an ad hoc approach…I think it was the wrong approach. Instead they sit around a table and debate as what the TAC should be and that's what to do [to date].

In addition, one key informant with experience in both state agency and conservation science observed that the increased need to place scientific findings in the context of decision-making and the mis-interpretation of science due to poor communication affects the role of science in fisheries management:

…As a scientist, when you get familiar with the bureaucracy, you have to place the science in the context of the decision making framework...I hate it when communication is filtered, misrepresented, undue control on the flow of information, I think that's simply wrong from a societal perspective…

A fish harvester on the Northern Peninsula for instance complained that: "The government is not putting enough money into it to try to fix things, to come up with stuff that I'm not thinking about, like the Nordmore grid [by-catch exclusion devise], different grates for different fisheries...trying new ideas, like they are in [doing] in Norway and Iceland." These stakeholder concerns point to the need for the best available science and an appropriate institutional framework where science-policy debate is healthy and fruitful. With recent cutbacks in DFO spending and the disbandment of the Fisheries Resources Conservation Council, there are concerns that these challenges may persist with ramifications for fisheries rebuilding.

The limitations of single species and challenges of ecosystem-based approaches

Several concerns were raised, by scientists, fishers, and policy makers alike, regarding the single species approach to fisheries management and the challenges of implementing policies for ecosystem-based management. One key informant, a senior research scientist at DFO, further explained these challenges:

> Ecosystem science is very complex…We are going to have to invest in it. We are collecting more data these days. The simplest interaction is cod, capelin, and seals. Capelin is down, cod's down, seals are up, question is can we rebuild cod? Are there no cod because there is no capelin? If we could isolate those interactions and have some predictions, we might be able to influence decisions, but we can't even show the interactions right now. If we tried to do it in a computer simulation, if we culled seals 20%, what would be the impact on capelin. We can't tell you. The models are so dependent on the parameters…These things aren't perfect. Scientific advice is single species, based on assuming that these interactions don't happen. There's variability but things are changing that much over time. Managers are not geared up to trading off species…You can't have MSY simultaneously.

In addition to challenges in implementing ecosystem-based approaches towards rebuilding, a fishery research scientist also identified evolutionary change as a major limiting factor:

> Fish evolved to live in the ecosystem for millions of years. Then we came along and created a strong pressure. The fish changed to compensate for that. The debate is whether it is due to genetic or phenotypic plasticity. Couple of papers says that it's an evolutionary change- they are maturing younger, growing slower, and mortality is higher. The overall impact is that they are less productive…We've seen ecosystem changes, for

example on the East Coast, capelin was much more dominant. Fish are less reproductive, even harder to rebuild them. You've got to rebuild the life history.....

This concern is supported by earlier studies done on Northern cod that reflected on evolutionary changes on rates of maturity and life history traits (Olsen *et al.,* 2004). Such evolutionary changes have implications for predator-prey relationship and for management measures in setting harvest rules on cod prey (capelin). Some of these management dilemmas have been addressed through a participatory process. A good example is the DFO's Regional Assessment Process[10] for peer review, which allows stakeholders to provide inputs into policy decision-making and deliberate on precautionary approaches for harvest decisions.

The move towards ecosystem-based approaches in the post-collapse period has led to efforts towards stakeholder involvement and knowledge synthesis for marine conservation policies. Because knowledge takes many forms, there is a need to integrate both formal and informal knowledge systems, undertaking interdisciplinary scholarship, and participatory research for decision-making (Neis and Felt 2000; Degnbol *et al.,* 2006). In the pre-collapse period, local ecological knowledge was largely ignored in science and policy, because of top-down management and poor stakeholder involvement. With the collapse of the fish stocks and criticisms of scientific uncertainties in stock assessment, local knowledge and user participation have become more important in rebuilding initiatives and in stewardship.

In this context, fish harvesters, in particular, suggested how their acquired traditional ecological knowledge could be useful in stock assessment and tagging studies, and as part of participatory and collaborative strategies. One key informant remarked on the relevance of knowledge synthesis: "one of our biggest failures I think is to connect the two groups of people that should be working together much more closely [fish harvesters and scientists]. With [their]

[10] http://www.dfo-mpo.gc.ca/csas-sccs/process-processus/particip-eng.htm last accessed May 28th 2011.

two distinct sets of knowledge… find[ing] more ways to mesh the two; if you don't mesh them, you get this conflict all the time. You [can] develop better relationships in a mutual respect." These participatory approaches in both science and policy have included fish harvesters' collaboration on stock assessment through tagging and sentinel surveys, as well as in developing conservation harvest plans. These efforts are crucial for trust and legitimacy and lead to compliance and greater stewardship ethics, which are necessary prerequisites for rebuilding.

Related to participatory approaches in the Northern Gulf, the Large Ocean Management Area (LOMA) program was mandated under the *Oceans Act* and the Oceans Strategy through an Integrated Management program that adheres to precautionary principles, shared responsibility, and for broader stakeholder involvement in ecosystem based management. The LOMA mandate falls under the Gulf of St. Lawrence Integrated Coastal Zone Management committee that was formed in 1999. It involves a multi-level stakeholder team including federal and provincial agencies (DFO, Parks Canada and DFA), the fishing industry, two Regional Economic Development Boards in the Northern Peninsula (the Nordic Economic Development Corporation and the Red Ochre Regional Economic Development Board), municipal governments, and civil society groups. The achievements of the steering committee include identifying and mapping ecological sensitive spots such as coral reefs, developing pilot projects for Integrated Management plans in two communities (Blanchard and Wall 2009), holding annual forums and policy deliberations (GNPFT 2006), conducting stakeholder workshops on issues scanning, and forming institutional partnerships for resource management and collaborative governance[11].

These initiatives have potential for stakeholder input into future rebuilding strategies in the region, as well as providing a platform for civic engagement on rebuilding strategies. To date, there are concerns that the LOMA program may not get into the next phase of

[11] http://www.coastalplanninggnp.ca/ last accessed December 14th, 2011.

implementing an integrated fisheries management plan, as budget cuts and strategic reviews will affect the future implementation of these local programs.

The significance of harvest decision rules and recovery targets

According to Hutchings (2000), the lack of any criteria to monitor trends in the level of vulnerability for marine commercial fisheries especially cod, may worked against achieving conservation objectives and effective recovery. Successful stock recovery planning requires a transition period for stocks to grow, and the use of harvest decision rules for monitoring stocks in meeting target reference points (Wakeford *et al.,* 2009). These scientific procedures are critical for monitoring recruitment and growth rates, and providing feedback response to stakeholders and policy makers (Murawski 2011). Caddy and Agnew (2005) proposed two key indicators for monitoring stock recovery: an increase in spawning stock biomass (SSB) to about 40%, and an increase in mature biomass to about 75% of historical maximum sustainable yield (MSY) levels.

Stock assessment data by DFO (2010a) indicates that both the matured biomass of 3 year+ and SSB have declined from historical high in the pre-collapse periods in the 1980s to historical lows in the post-collapse periods in the 1990s. Trends in SSB peaked in 1983 at about 378,000 tonnes and then gradually declined to 9,000 tonnes in 1993, prompting a complete moratorium from 1994 to 1996 (Figure 3). In the post-collapse period, the SSB has slightly increased and averaged about 38,000 tonnes (DFO 2005). This trend suggests that the stocks are far from recovered to historical highs in the early 1980s prior to the collapse. Similarly, the total 3 year + biomass increased from 300,000 tonnes the mid 1970s to twice this amount in 1983, and gradually reduced to about 26,000 tonnes in 1993 as shown in Figure 3. Since the first moratorium in 1994 to 1996, the 3 year + biomass slowly increased to about 50,000 tonnes in early 2000s, but declined steadily leading to the second moratorium in 2003. The 3 year +

biomass have steadily peaked up again from 2004, increasing to about 80,000 tonnes in 2008 (DFO 2010a).

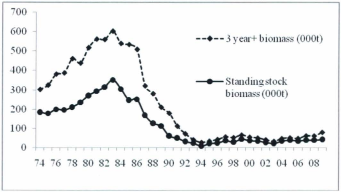

Figure 3: Trend in biomass estimates for Northern Gulf cod stocks based on DFO stock assessment data and recovery indicators proposed by Caddy and Agnew (2005).

Interview responses from research scientists in both academia and state agencies concur that there is a lack of harvest decision rules employed in setting target and limit reference points in recovery planning in Canada. Unlike Canada, decision rule-based approaches and conservation reference points are strictly adhered to for setting TACs and monitoring stock rebuilding points in the US (Shelton and Rice 2002; Caddy and Agnew 2005). These policy measures in the US, which are enshrined in the revised Magnuson-Stevens Act, are required to prevent overfishing and rebuilding collapsed stocks. So far, these legal mandates have contributed to the rebuilding of twenty one collapsed stocks from 2000 to 2010, including the Georges Bank haddock (*Melanogrammus aeglefenus*), Atlantic Pollock (*P. pollachius*), and spiny dogfish (*Squalus acanthias*) (NMFS 2011). In addition to the biomass and MSY reference points, the Fish Stock Sustainability Indicator is also used in the US as a performance measure to evaluate and monitor fisheries rebuilding, in addition to dealing with equity and uncertainties (Hanna, 2010).

Northern Gulf cod was designated as threatened in 2003, and is now considered endangered as of April 2010 by COSEWIC (DFO 2011). Recovery potential assessments on the necessary scientific criteria and requirements for listing have been undertaken regarding decisions to list the species as endangered and for subsequent recovery plans and strategies. A conservation limit reference point has been estimated at 116, 000 tonnes, and the SSB has been below this limit point since 1990 and stood at 16, 000 tonnes in 2010 (DFO 2011).

According to Rice *et al.* (2003), the high levels of dependency on the fishery resource and scientific uncertainties about stock abundance have provided justifications for ignoring proposed harvest decision rules in the Canadian context. Key informants suggested that this is due to the lack of broad-based governance approaches that barely consider diverse stakeholder interests during agenda setting. An inclusive approach that considers avenues towards precautionary approaches, effective harvest decision rules, transitional livelihood strategies, and compliance by resource users are central to successful rebuilding.

Natural factors and management decisions interacting to stall rebuilding

Key informants identified both natural factors and human management decisions that have inhibited the recovery transition and successful rebuilding. These include: i) poor recruitment and growth rates and environmental changes; ii) continuous directed fishing for cod and for capelin and herring that cod preys upon; and, iii) stock mixing and unregulated fishing concerns.

Scientific assessment of cod juveniles indicate that recruitment rates for Northern Gulf cod stocks are below conservation reference points since the stocks collapse in the early 1990s (Rice *et al.,* 2003; DFO 2010a). Using the 3 year + cohorts as an index of recruitment, the stocks have fluctuated from an estimated historical high of 206,000 tonnes in 1980 to a fluctuating and steady decline to about 13,000 tonnes in 2008 (Figure 4).

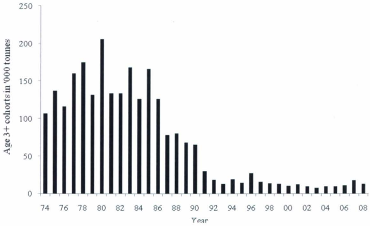

Figure 4: Trend in 3 year + recruits of Northern Gulf cod (Source DFO 2010)

Many of the key informants, primarily fish harvesters and managers, expressed ambivalence towards the recovery prospects of Northern Gulf cod fisheries. As one fish harvester in Rocky Harbor observed: "I could see cod coming back [past years]…but this year, for whatever reason I don't know… there was some cod, but there was not the abundance that have been in the last number of years…and what did show up was in very poor condition". This observation is corroborated with recent DFO findings on cod biology: "…the mean length-at-age for older fish and age and size at maturity remained at lower levels now than in the 1980s. Cod start maturing at age 4 and the size at 50% maturity is currently about 45cm at age 5 (DFO 2010a: 3). This reflects challenges with recruitment and growth rates, food availability, and cod biology. In addition, Northern Gulf cod has experienced higher natural mortality from the mid 1980s to the mid 1990s leading to stalled rebuilding (DFO, 2005). This poor growth rate has been partly attributed to food availability and cold oceanographic conditions, which have had a negative impact on growth, size and sexual maturity (DFO 2010a).

Furthermore, high fish exploitation rates from 1999 to 2002 have been identified as a contributing factor to stalled rebuilding, with present exploitation rates "inconsistent with a rebuilding strategy" (DFO 2010a: 11). Moreover, there is high fishing pressure for commercial fisheries that target capelin and herring on which cod preys. As noted by a key informant in western Newfoundland where there is a significant commercial pelagic fishery: "I can't see how stocks can recover when we are still fishing capelin and other stuff, how can the fishery recover when we are destroying the very foundation for the fishery"

Related to recovery prospects are concerns about growth and recruitment overfishing. Although some key informants including managers and fish harvesters are optimistic about long term recruitment rates in the future, concerns were raised about the survival of small juvenile cod that are often caught as by-catch in mixed fisheries or discarded because of their small size. For these reasons, fishery scientists at DFO are now using a survival index to measure the rate of successful recruitment and to use precautionary approach in setting harvest decision rules and TAC quotas. Similarly, the concept of reproductive value of spawners has been used to determine the level of viability of a population mainly for sedentary fish such as lobsters (Rideout 2007).

The concerns listed above about population viability have led to policy recommendations for protecting spawning areas in certain bays in western Newfoundland. One key informant, a fish harvester in the 3Pn region around Port Aux Basques, underscored how closed areas and a closed fishing season have been initiated and implemented by fishers around Bay St. George in Port Aux Port Peninsula to protect spawners primarily for cod and halibut. DFO has additionally implemented a seasonal closure to fishing from April 1st to June 15th (DFO, 2010a). These initiatives call attention to the role of stakeholder involvement and participatory governance for stewardship and local conservation initiatives. In the 4RS region in Quebec and western Newfoundland, however, the use of gill nets is the biggest obstacle to protecting cod spawners. According to one key informant, a fisheries manager:

> One thing that concerned us a little while ago… in 2007 and 2008, there were the largest fish being landed in size since we monitored the stock in 1974. The reasons for that may be the choice of gear; there is more and more gill net fishery…[which] catches larger [spawning] fish.

Whilst fish harvesters in the 3Pn region prefer using long lines and hooks, fish harvesters in the 4R region prefer gill nets. According to a fish harvester in the Port Aux Basques region who fishes in 3Pn, "Hook and line is the safest way to catch fish and it is the best quality". Fish harvesters in the 4R region on the other hand claimed that the stocks are already 'belly full' by the time they migrate from 3Pn to 4R on their summer feeding migration. The stocks therefore do not adequately respond to baits on lines or hooks, so they rather prefer gill net fishing as it is most cost effective.

The migratory nature of the stocks and their possible mixing in other NAFO regions also raise rebuilding challenges about the 'fit' of management boundaries to policy instruments, such as effective harvest policies and fishing activities. Fish harvesters interviewed in the 3Pn region were apprehensive about successful recovery due to the migration patterns of 4RS3Pn stocks and on-going winter fishing activities in NAFO region 3Ps. Local fish harvesters and scientists agree that the stock might have been 'hammered' during its winter migration and related possible stock mixing around Burgeo and in other areas. Whereas the 2010/11 TAC was reduced to 2,000 tonnes in the 4RS3Pn region, the TAC in 3Ps was maintained at 11,500 tonnes despite the fact that this TAC was not landed last year (DFO 2010c). Besides, these concerns contribute to the legitimacy of fisheries management measures and power imbalances as discussed in Chapter V. Part of this challenge has been addressed in the post-collapse period through seasonal and area closures from mid November to April along the Burgeo Banks in 3Ps region (DFO, 2010a).

Other emerging concerns include developing habitat protection measures and residence times for migratory stocks, the impact of oil and gas exploration and seismic activities on habitats and stock behavior, coastal eutrophication, and invasive species such as Green Crab that impacts habitats for juvenile cod (DFO 2011).

Changes in harvesting policies and impact on transitional livelihoods and stewardship

Rebuilding means different things to various stakeholder groups, adding to the complexity of definitive outcomes, and the diverse expectations of what rebuilding brings forward. Whilst most fisheries scientists and managers regard rebuilding in terms of stock recovery using biological reference points; conservation biologists are more concern about improving biodiversity and resiliency; and resource users and dependent coastal communities see rebuilding in terms of secured livelihoods and the preservation of culture fishing for current and future generations.

An analysis of policies along the fish chain in the pre- and post-collapse era shows that some policy changes have contributed to resource sustainability through better control and surveillance mechanisms, as well as unintended consequences on livelihoods and community viability. This highlights a contested viewpoint of what is been rebuilt and for whom. Rebuilding is a wicked problem because of these multiple challenges within and beyond the pre-harvest stage and harvest stages, and the domino effect on livelihoods and communities embedded along the fish chain. As shown in Table 1, key informants identified several changes in the pre-harvest and harvest stages relevant to resource sustainability and having unintended consequences on fishing livelihoods. These changes are further discussed under three key themes: i) by-catch and multispecies concerns; ii) changes in access policies and its ramification on equity; and iii) transitional livelihood and cultural heritage concerns.

Table 1: Changes in management policies relevant to understanding rebuilding barriers and opportunities

Policy measures along the fish chain	Pre-collapse period	Post-collapse period
Pre-harvest stage	Abundance of cod stocks and high predation flow from groundfisheries.	Depletion of cod stocks and a trophodynamic shift in predator-prey relationship.
	No specific conservation measures for ecological hotspots or sensitive habitats such as spawning areas.	LOMA efforts in identifying ecologically and biologically sensitive areas and creating protected areas or seasonal closures.
	No policy process and legal mandate for risk or vulnerability assessment	Enactment of SARA and the role of COSEWIC in the listing process of vulnerable species.
Harvest stage	Misreporting, high grading, illegal and unreported catch.	Dock-side landing and monitoring programs, in addition to log books and vessel monitoring.
	Mostly groundfisheries targeted.	Mostly shellfisheries and small pelagics targeted.
	Presence of foreign and dragger mobile trawler fleets.	Absence of foreign and dragger trawler fleets and a predominantly fixed gear fishery.
	Multispecies licenses and limited restriction on catch landings.	Multispecies licenses but restrictions on certain by-catch species.
	Open access to community residents and predominance of input control measures.	Closed access with professionalization based on fleet ownership, dependency, and experience.
	Enterprise allocation for individual vessels for offshore fleets and competitive fishery for inshore fleets.	Enterprise combining policies to include individual transferable quotas, 'buddy up' system, license buy-outs, and quota consolidations.
Institutional mechanisms	Poor consideration towards regional or community quotas.	Regional quota allocation system implemented in Northern Peninsula.
	Top down management and single species approach.	Integrated management and a move towards ecosystem approach and stakeholder involvement.
	Limited role for FFAW in shared stewardship and conservation initiatives.	Greater involvement of FFAW in sentinel fisheries, cod tagging studies, and provides inputs to conservation harvest plans.
	High dependency on groundfisheries in both harvesting and processing sectors.	Low dependency on groundfisheries as stocks collapsed, plant closures, and loss of jobs.
	Limited attempts at integrated livelihood and regional planning initiatives.	Greater emphasis on integrated management and regional economic development through the creation of REDBs and other programs.

By-catch concerns

With the collapse of the groundfisheries, several stocks are regulated with by-catch regulations. For example, there are current by-catch restrictions for cod in the directed turbot fishery. In essence, compliance to by-catch limitations in multispecies fisheries is necessary for cod stocks to grow and mature to healthy levels and to meet rebuilding targets without problems of recruitment overfishing. The by-catch challenges were explained by a fish harvester in the Bonne Bay region (4R):

> We always had what was called a multispecies harvesting plan where…back in the early 80's, if you went out and set your trawl and you had 200 pounds of flounder, 500 pounds of cod fish, 300 pounds of halibut, you brought it all in. You take a pick up to the plant, so the catch you made you would get. Now if you come in, Christ Almighty, I'm almost afraid to come up around the wharf because DFO is going to charge me something.

Most of the key informants in various stakeholder groups in the fishing industry are aware of the persistence of by-catch issues in both the pre- and post-collapse periods. The reasons for non compliance to by-catch regulations vary by stakeholder groups and by regions in the Gulf of St Lawrence. For instance, discards and by-catch are generally higher in the 4RS region where gill net is predominant and lower in 3Pn region where hook and line is the main fishing gear. In the 3Pn region, fish harvesters have adopted a solely hook and line gear and constructed a museum to promote this stewardship ethics in the region. Additionally, some fish harvesters suggested initiatives towards landing and reporting by-catch without penalty, and more involvement in conservation policies, recognizing that these issues affect their livelihoods and successful rebuilding outcomes.

Changes in access policy and equity implications

The collapse of the groundfisheries brought in new access and allocation measures that encourage output control measures such as individual transferrable quotas for shellfisheries, enterprise combination policies, and access restrictions through the 1997 Professionalization Act. Premised on core and non-core fish harvester categories, professionalization of the fishing industry entails limiting access and entry based on level of dependency, years of fishing experience, and enterprise ownership (Cashin 1993; GTA Consultants Inc 1993). A core fish harvester is a full time, experienced enterprise owner with license(s) to fish key species such as cod, crab, and shrimp who obtains 75% of his/her income earnings directly from fishing activities. Others are considered non-core fish harvesters and would be mainly new entrants who need to go through an initial Apprentice Program. Upon successful completion of this training, the Apprentice Program leads to an advanced fishing Level I, then to Level II, and ultimately to a core fish harvester level. The Professional Fish Harvesters Certification Board, created in 1997, is mandated to provide training programs and courses to non-core members. Upon meeting certain criteria and approval from DFO, core fish harvesters can sell their fishing enterprise or transfer to a family member who is at Level II (Schrank, 2005). Non-core enterprises (Level I or II), however, can neither be transferred nor sold. These policy changes were identified by several key informants to have ramifications on stewardship ethics, distributional and intergenerational equity especially on the question of 'rebuilding for whom', and the viability of fishing dependent communities. One of the biggest changes identified by key informants especially fish harvesters and managers was the rapid shift in target species from groundfisheries to shellfisheries, and changes in processing infrastructure from labour intensive to mechanized infrastructures. As shown in Table 1, the post-collapse era has seen changes in access and allocation measures for new market opportunities through a shift in target species to shellfisheries. What is more, key informants in the fishing industry talked about new emerging markets in Europe and Asia that hold promise for these new species with higher landed values and profit margins.

The increased harvesting rate of shellfisheries has raised many other concerns such as those related to long term resource sustainability and the huge transformation in the processing sector. The total shrimp landings in NL have increased from 20,000 tonnes in 1990 to 120,000 tonnes in 2008 (DFO 2010b). Similarly, total crab landings in the province increased from 8,500 tonnes in 1987 to 70,000 tonnes in 1999 (DFO 2010b). Further, from the perspective of harvesters and processors benefiting from the shift to shellfisheries, cod recovery may reduce the abundance of shrimp and crab, and jeopardize their incomes and profits. One key informant (a plant manager) raised a major concern about the changes in harvesting and processing infrastructure in the event of cod recovery:

> . . ..Well, we could not cope with that right here today [cod abundance], and neither could any of the plants down the [west] coast because they are all shrimp. You would have a lot of changes; someone would have to invest in [new] processing [for cod]. I have a problem picturing what the cod fishery would look like if they were to come back. Depending on how that transpires, that would determine if someone would build a processing plant on shore. A lot of fishermen have retired since 1992; [the] thing is the younger people are not interested. I think that if cod comes back it should come back as a hook and line fishery, and we should conduct it at the time of year when we can have good production [value].

According to one key informant, a fisheries manager with DFO, the policy changes in target species from groundfisheries to shellfisheries came with allocation changes as well. For instance, in the post-collapse period and in the context of very small TACs for cod, most mobile gear quotas were allocated to fixed gear inshore boats, especially in fishing dependent regions such as the Great Northern Peninsula. As mentioned by one fisheries manager, these initiatives were spurred by "The Dave Decker Plan", initiated by David Decker on behalf of the FFAW to redistribute unused mobile offshore quotas to inshore fishers. However, most fish harvesters interviewed in both 4R and 3Pn regions were uncertain about future stock abundance and allocation measures in the event cod rebuilds to historical levels or shrimp quotas decrease because of predator prey relationship.

As argued earlier, rebuilding is a wicked problem partly because solutions are consequential with policy ramifications. This means that new problems can emerge from program implementation of proposed solutions. In the case of professionalization, the new policy change of restricting access, along with the high cost of fishing licenses, has made it almost impossible to get new entrants or youths to enter the fishery. Additionally, the low economic returns and the high levels of debts within the fishing industry and associated demographic trends highlight intergenerational equity concerns related to who would benefit when the fishery is rebuilt, and what species and stocks will exactly be rebuilt.

Transitional livelihood concerns, cultural heritage, and coastal community viability

The adjacency principle, based on the law of the sea and national constitutional mandate, is a useful mechanism for administering territorial use rights and cultural claims for coastal communities in Canada especially during rebuilding transition (DFO 2002b, 2004). The principle provides justification for equitable allocation and access policies especially during restructuring, transitional livelihood considerations from collapsed to rebuilt fisheries. A research analyst in St. John's commented on the issue:

> 'I think the adjacency principle is the key point but how do you operationalize it. That's the trick, nobody has ever done that in this [rebuilding] context…the Americans have a much more federalized system with regional management councils…in the Philippeans, the municipal level is where the action is. I'm not saying that is necessarily the best approach. The fed government [in Canada] is in the drivers seat, but the people in the regions have no say, they are disempowered, disenfranchised…Most sectors you have

boards, boards where decisions are made transparently. The Minister makes decisions that blow up in their faces because they have no mechanism to include communities. I think that's a failure of bureaucrats, if you can't have communities interacting in a rational way, we [society] have failed to provide politicians with that mechanism.'

Another issue raised by key informants linked to rebuilding prospects and community viability was the annual recreational or food fishery. In the pre-collapse period, there was no restriction on recreational fishing for cod and most families enjoyed sharing these cultural past times. After the collapse, restrictions were imposed, with a limited catch of up to five fish a day and a maximum of three people in a given boat. According to the 2007 Survey of the Recreational Fishery in NL commissioned by DFO, about 161 tonnes of cod fish were caught in the 4R3Pn region in Newfoundland in 2006, by 6,584 residents ranging from youth to seniors. The recreational fishery, which lasts about five weeks in the summer, has limited surveillance and dockside monitoring system in place, and has implications for food security, compliance, and cultural heritage.

Using an inventory system of community food systems in the Bonne Bay region in western Newfoundland for instance, Lowitt (2009) found strong cultural and social relevance of the recreational fisheries to seafood security and fishing traditions. It also identified local concerns along the supply chain, which mostly caters for global markets and pay less attention for community needs and local marketing. According to provincial regulations in NL, fish harvesters are not allowed to sell their catch directly to local residents or at the wharf, except to fish buyers and processors who also need licenses to do so. This system creates problems in the non-fishing season, when access to fish is only possible at retail stores and prices are far higher because of handling and transportation costs (as discussed in Chapter IV).

In addition to the recreational food fishery and the community dimension to fish marketing as discussed above, there are loss of livelihoods and concerns about distributional equity during the rebuilding transition. According to the GNPFT (2006), about 50% of fish harvesters and plant workers have lost their livelihoods since the cod fishery collapsed as shown in Figure 5. This illustrates the interlinkages between the various production stages starting from the pre-harvest stage to the harvest and post-harvest stages, and the ripple effects and changes it produces along the entire production chain.

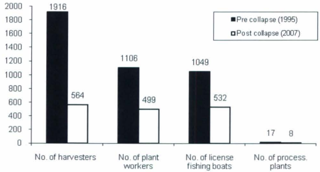

Figure 5: Socioeconomic impact of cod fisheries collapse in the Northern Peninsula

(Source: GNPFT, 2006)

The high level of dependency on the fishery resource for surviving harvesters and their households, particularly in recent years due to the absence of transitional livelihood programs have implications for the successful achievement of rebuilding targets. This was underscored by one key informant, a senior fisheries manager with DFO: "the short term consequence [of rebuilding] is immediate with dramatic impacts on communities that are socially and economically dependent on fisheries. Without a transition plan, [there is] real economic and social hardship."

According to one key informant, a fisheries manager, emerging bottom-up governance initiatives in the post-collapse period including regional quota allocation have been identified as a unique model to address equity and livelihood concerns, as well as a stimulus for regional economic development as discussed in Chapter V. These governing arrangements could be better situated to deal with the wicked rebuilding challenges especially in the pre-harvest and harvest stages, as stakeholders are interested in stewardship initiatives and share responsibility. In addition to developing initiatives towards livelihood transition strategies, institutional partnerships and addressing intergenerational equity concerns and the question of 'rebuilding for whom' are central to rebuilding success.

Institutional inertia, policy disconnects, and scale mismatches

The fish chain framework and key informant responses highlight concerns around adequate institutional mechanisms for fisheries rebuilding in addition to policy coherence across the various production stages. As discussed earlier, the lack of a rebuilding plan that details targets and harvest control rules in the Fisheries Act and SARA demonstrates serious shortcomings and institutional inertia towards rebuilding success. Developing rebuilding plans and harvest control rules as mandated under the revised Magnuson-Stevens Act, in addition to participatory governance mechanisms are crucial for community and livelihood transitional challenges. These community dimensions have been central to the success of stock rebuilding in the US and for implementing catch share programs (Wakeford *et al.,* 2009; Ecotrust, 2011).

Despite the collapse of the groundfisheries in eastern Canada, which resulted to the largest layoff in Canadian history, no legal or constitutional changes have been made to the Fisheries Act to accommodate fisheries rebuilding or transitional challenges in ecosystem or livelihood transitions (Hutchings 2010). Moreover, the institutional design of the fishing industry in NL has evolved over the past centuries to include policy disconnects between the federal and provincial governments, as well as the harvesting and processing sectors (Kirby 1982; Storey 1993; Schrank 2005). Issues of constitutional power and agency have historically been central in the debate, with current arguments about blame, accountability, and responsibility (Hutchings *et al.,* 1997; Cadigan 2004). According to the Office of the Auditor General's Report on the Environment and Sustainable Development: "the [federal] government must decide how access will be divided among the various stakeholders who have claims on the resources…[and] must take account of principles of equity and constitutional protected rights, such as the Supreme Court ruling that allowed some Atlantic fisheries to be used by Mi'kmaq and Maliseet First Nations" (OAG, 2011: p. 10).

The SARA enacted in 2003 (Irvine 2005), is also not well suited to listing commercial species, as reflected in the debate about COSEWIC's recommendation for listing (Hutchings and Festa-Bianchet 2009). In the case of marine fisheries, it is the joint responsibility of three federal agencies, namely DFO, Parks Canada, and Environment Canada. For a species to be recovered under the SARA mandate, the species has to be listed based upon recommendations on the level of vulnerability by an independent panel of experts - the Committee on Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC recommendation to list Northern Gulf cod stocks was disputed on the grounds of negative socioeconomic implications for fishing dependent communities and fishing livelihoods (DFO 2005). Conversely, the non-listing of cod as an endangered species has consequences for the livelihoods of cod-dependent coastal communities and for long-term recovery prospects. A research scientist commented on the issue:

> Cod will never be listed. No fisheries department will ever list cod. I think that's ok. COSEWIC is going to assess cod again, I have no idea what the assessment will look

like. Some people say it is never going to be listed…The fact that it will never get listed, that's OK from a science communication perspective. It helps to put it to public [scrutiny]…DFO can and should be held accountable.

Three scenarios and associated recovery plans have been proposed through SARA for listing Atlantic cod stocks following cost benefit analyses. These include: a) no direct fishery with some allowable by-catch; b) prioritized rebuilding with 50% by-catch; and c) maximum rebuilding with a zero by-catch (DFO 2005). These proposed listing scenarios have implications for the recovery of fish stocks, lost revenue, and livelihood opportunities. According to DFO (2010b), sustainable harvesting methods and gear use policy through eco-certification are central for rebuilding and market access, although none of these measures have been enacted to accommodate the stalled rebuilding for cod. Sustainable harvesting practices and eco-labeling considerations may promote support from conservation campaigns such as Sea Choice and David Suzuki through consumer awareness campaigns.

The lack of inclusion decision-making and difficulties with legislative changes was identified by the Fisheries Resources Conservation Council of Canada as barriers to rebuilding: "the top down prescriptive nature of the *Species at Risk Act* [which], will largely remove industry from participation in management of the resource, and will counter initiatives towards stewardship and co-management. Governance and management will also be considerably aided by modernization of the *Fisheries Act*" (FRCC 2011: 5). A senior research scientist further lamented on the shortfalls of the SARA process:

There was no long term evaluation [for recovery]; no value was placed on non-use... I'm concerned about species without [non] economic value; by-catch is still an issue...The government will not list any species with economic benefit. They nuked it, they blew it up. That would have been a positive way. Instead they said they are going to deny every listing. If they had accepted the cod stock as threatened, they would have put in a timeline for recovery. But instead, they said no, we're going to go [along with] this Cod Action Team. They never considered the trade offs. That would have been extremely positive, but instead they created a smoke screen. Read the report it's just nothing, totally useless. There's no rebuilding plan for the cod stocks currently. We're still doing it year by year. Take as much as you can this year, we'll worry about next year when it comes. Without a plan, I don't think we are going to rebuild these stocks, unless nature gives us a miracle.

To date, there is no rebuilding plan, implementation strategies and timelines. Moreover, rebuilding initiatives in SARA have not been properly linked and coordinated with the Oceans Act, especially for Integrated Management and in providing transitional and integrated livelihood strategies with eco-tourism (see CURRA 2010). Key informants identified these shortcomings as opportunities for institutional innovation and stakeholder partnerships for rebuilding by taking into consideration integrated management. Municipal leaders and regional planners interviewed also showed interest in participating in fisheries rebuilding initiatives at the local community level. A discussion with a fish harvester in Bonne Bay on who should participate underscored the role of community representation and the need for inclusiveness: "Yeah, a lot of community leaders would sit in, not only for the fishery, but then the fishery is going to hold your community together."

Furthermore, some study participants identified disconnects and scale mismatch between resource management boundaries, livelihood activities, and jurisdictional boundaries. Understanding the causes and consequences of the mismatch of management systems in relation to ecological processes, institutional linkages, and fit across jurisdictional boundaries have been the focus of attention in recent decades (see Young 2002; Cumming *et al.* 2006; Wilson 2006; Ekstrom and Young, 2009). Scale matching of institutional mechanisms to ecosystem and socioeconomic boundaries are essential for resilience, social learning, lower transaction costs, adaptive capacity, and participatory decision-making that may lead to effective rebuilding. In the case of the Northern Gulf cod fisheries, this is even more so with knowledge gaps on stock migration patterns, and fishing activities within and outside the 4RS3Pn jurisdictional boundary.

A senior fisheries manager in Ottawa commented on the issue of scale-matching and local involvement: "We are really talking about nested problems and nested scale [solutions]… the top-down management models work at the scale that they are good at working at [national and regional]. They cause havoc at the finer scales. The bottom-up [approach] is not good at working at large-scale problems…This is a classic problem." This comment calls attention to the relevance of context in rebuilding planning and implementation. Another key informant, a regional economic development officer, pin pointed the problem on too many administrative jurisdictions and socioeconomic boundaries that are not well coordinated and span across municipal, provincial and federal mandates with little collaboration. For example, within the Northern Peninsula in western Newfoundland, there are two REDBs, several municipalities, and fishing cooperatives, in addition to several provincial and federal government agencies with limited institutional structure for communication and interaction. To deal with these concerns, key informants, predominantly inshore fishers, mayors, and community planners suggested a larger role for municipal and regional involvement through bottom-up approaches.

Most key informants supported the need for participatory governance and for nested institutions appropriate for different scales of governance in dealing with management challenges and addressing equity concerns. According to a retired civil servant:

'....put as much responsibility as possible on a localized idea. If you don't do that, if you manage a fishery from a region, all the problems bubble up to that level. The higher up they go, the more difficult it is to solve it, *remoteness of the problem* [emphasis added]. [At] a political level, you don't get a solution, the manager of fisheries and oceans Canada doesn't have a good handle on what is happening in Rose Blanche [a fishing community]...the more authority you have, the more accountability [you give].'

Summary and policy implications

By conceptualizing fisheries as a wicked problem, a fish chain approach helps identify challenges and opportunities across the entire production chain. The comparative analysis in the pre-harvest and harvest stages identified five key rebuilding challenges: i) ecological constraints in growth and recruitment, predator-prey relationships, and lack of multispecies considerations; ii) high exploitation rates, along with inadequate research on harvest control rules and stock migration patterns; iii) poor focus on integrated livelihood programs and transition models that could foster community involvement and stewardship; iv) professionalization impacts on youths and concerns about intergenerational equity; and v) institutional inertia and lack of policy initiatives for collaboration and to influence successful rebuilding. Recent estimates and projections in achieving stock recovery are dire, and if present fishing conditions and productivity continues, the population is expected to increase in the short term but subsequently falls down to 2010 level (15% of the limit reference point) by the year 2046 (DFO 2011).

This pre- and post-collapse analysis of the two stages of the Northern Gulf cod fish chain indicates that rebuilding is very challenging due to the complexity of fisheries ecosystems and the mixed results of policy changes that are both beneficial and detrimental. As shown in Table 1, changes in management measures due to stock collapse in the pre-harvest stage illustrate that rebuilding is not only about the natural systems; somewhat the socioeconomic and institutional dimensions are also central to rebuilding success. There was a general agreement amongst key informants that coastal fishing communities are strongly dependent on fisheries and that the fisheries are in turn dependent upon these coastal communities for local stewardship. However, key informants cited many examples of how coastal communities have been marginalized and poorly represented in the fisheries restructuring and rebuilding decision-making. For example, restructuring programs in the early 1990s were ineffective because they ignored linkages to community development on the Northern Peninsula (Holland *et al.,* 1999). An OECD 2007 Report drew attention to shortfalls in restructuring and the need for institutional partnerships and scale-matching: "what is clear from Canada's experience is that fisheries departments alone will not have the answers, and success will require a whole governance approach that includes partnering with community stakeholders. Solutions will remain costly and require significant long-term planning and flexibility to be successful…" (Ruseski 2007: 73). In addition to livelihood issues, there are current challenges with scale matching of fishing activities relative to jurisdictional boundaries, and stock migration patterns. These challenges provides opportunities for knowledge synthesis, social learning opportunities amongst stakeholders, and developing adaptive capacity and feedback strategies for better outcome. There are diverse stakeholder interests along the fish chain, with limited opportunities for broader agenda setting and stakeholder inputs into decision-making especially on stewardship, allocation mechanisms, livelihood options, and other community viability concerns. This implies that fish chains require a high level of coordination across the various production stages and effective institutions that match their mandates at various governing scales.

Drawing from international experience, the success of the US rebuilding programs for four species are attributed to legal and institutional mandates under the revised Magnuson Stevens Act, robust scientific process, and policy development that is inclusive and sensitive to stakeholders and regional and local contexts (Wakeford *et al.* 2009; NMFS 2011). The various Acts (Fisheries Act, Oceans Act, and SARA) and corresponding federal-provincial policy initiatives could lead to far more successful outcomes with stronger institutional linkages and policy coherence across the fish chain. Moreover, changes in management policy such as by-catch measures and area closures that recognize stakeholder inputs may get buy-in and compliance as demonstrated in the 3Pn region in southwest Newfoundland.

The challenges identified using this approach and according to key stakeholders are opportunities for the development of better governing options through institutional partnerships, effective transitional programs, and interactive communication. Because fisheries rebuilding involves multiple spatial, temporal and governance dimensions; stakeholder deliberations on trade-offs between long term gains and short term costs could highlight the imperative to explore governing options and transition livelihood opportunities.

In conclusion, defining fisheries rebuilding as a wicked problem provides opportunities to better understand and address the multifaceted concerns along the entire fish chain. Paying attention to cod stocks and multispecies interactions, transitional livelihood programs, institutional mechanisms for stakeholder buy-in and compliance, and scale matching, are essential requirements for shared stewardship and rebuilding success.

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Chapter IV: A Fish Chain Analysis of Wicked Rebuilding Problems: Harvest and Post-harvest Stages of the Northern Gulf Cod Fisheries

Introduction[12]

Northern Gulf cod fisheries found in the Gulf of St. Lawrence bordering Quebec and Newfoundland collapsed in the early 1990s. Despite many rebuilding initiatives and changes in management measures, stock assessments indicate there has been no significant increase in the abundance of Northern Gulf cod stocks. Furthermore, there are ongoing challenges threatening the viability of the fishing industry in this region and elsewhere in Newfoundland and Labrador (NL). I discussed in Chapters I to III that these challenges are complex and multifaceted and rebuilding collapsed fisheries should be understood as a particularly wicked problem. I argue that the usual stock recovery approach employed in fisheries management is insufficient to deal with the challenges associated with the wicked problem of Northern Gulf cod rebuilding. This is due to constraints in raw material supply, multispecies interactions, political economy issues relating to fish trade, eco-certification, economic viability, poor institutional response, and lack of stewardship incentives.

In this chapter, I examine how changes in seafood production in the harvest and post-harvest stages of the fish chain have affected local rebuilding prospects and the long-term socioeconomic viability of Northern Gulf cod fisheries and dependent communities. I do so by first reviewing literature on theoretical developments on fisheries management and supply chains to discuss the relevance of a fish chain approach in understanding seafood production and rebuilding prospects. Next, drawing on the fish chain framework and focusing on the harvest and

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post-harvest stages, I undertake a market analysis of seafood production in both the pre- and post-collapse periods to examine rebuilding challenges and opportunities.

Seafood is currently the most traded commodity internationally, with global exports exceeding 100 billion in 2009 (FAO 2010a). Fish landings and seafood trade has increased to nearly 40% in the past few decades, with approximately 80% of wild captured fish stocks fully exploited or overexploited (FAO 2010b). This current status of global fisheries raises concerns for biodiversity conservation, seafood trade, and food security (Pauly *et al.,* 2005; Smith *et al.,* 2010; Srinivasa *et al.,* 2010). Fishing affects marine food webs (Pauly *et al.,* 1998); especially as large predatory stocks are fished out, raising the possibility of cascade effects and regime shifts (Frank *et al*., 2005; Savenkoff *et al.,* 2007). In this circumstance, demand for crustaceans, which are lower down the food web, could affect resource sustainability and economic returns particularly in the absence of appropriate policy measures (Hannesson 2002).

Before the collapse of the groundfisheries in the early 1990s, Canada ranked second globally as a seafood exporter following the US (DFO 2008a; FAO 2009). Total landings and dockside value in 1988 were about 1.7 million tonnes and 1.6 billion CAD, respectively[13]. In 2006, after the groundfisheries collapse, landings decreased to around 1.1 million tonnes, with a total production value estimated at 4.2 billion CAD, placing Canada in the sixth place after China, Norway, Thailand, US, and Denmark (DFO 2008a). About two thirds of the total catch is currently landed in Eastern Canada, comprising mostly shellfish and small pelagic and NL contributed about a quarter of the landings in 2006 (DFO 2008a).

Total production value of all fisheries in NL increased to about one billion CAD in 1999, and fluctuated between 900,000 CAD in 2001 and 1.2 billion CAD in 2004. However,

[13] Department of Fisheries and Oceans Statistics: http://www.dfo-mpo.gc.ca/stats/commercial/land-debarq/sum/sum8891-eng.htm accessed July 20th, 2010.

production value declined to 830,000 CAD in 2009[14], due to global fluctuations in fish price, especially for shrimp (DFO 2008a). According to the 2010 Seafood Industry Review, total production value in 2010 for both wild capture fisheries and aquaculture reached 942,000 CAD.

The Northern Gulf fisheries in western Newfoundland contributed nearly 12% of the production value in 2004 (GNPFT 2006). Stakeholders in the Northern Gulf region are concerned about future economic returns from the fisheries, because of poor resource access, macroeconomic drivers, and changes in fisheries policies to accommodate global seafood market trends (GNPFT, 2006). Related to this is the red listing of Atlantic Canadian cod products by SeaChoice, a group of Canadian environmental conservation group that promotes marine stewardship and consumer awareness[15].

Conceptual approaches to marketing and international seafood trade have primarily focused on supply chain management and value addition of fishery products (Thorpe and Bennet, 2004), and less so on resource sustainability or stock rebuilding (see Folkert and Koehorst, 1997; Gudmundsson *et al*., 2006). In the case of rebuilding collapsed fisheries, there has been little emphasis on the interlinkages between ecosystems, resource sustainability, economic viability, and the role of institutions in rebuilding (OECD, 2010). Using the fish chain approach (Bavinck *et al.,* 2005), this chapter examines the interactions in cod seafood production, focusing on the harvest and post-harvest stages and their implications for economic viability and rebuilding prospects. I used a seafood market analysis that examines catch statistics, cost and earnings data, and trade flows; combined with key informant's perspectives on changes in supply chain organization and institutional mechanisms in both the pre- and post-collapse periods.

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[14] Department of Fisheries and Aquaculture, Seafood Industry Year in Review: http://www.fishaq.gov.nl.ca/publications/yir_2009.pdf accessed June 1, 2010.
[15] Seafood choice red listing of Atlantic Canadian cod products: http://www.seafoodsource.com/newsarticledetail.aspx?id=4294990365 accessed June 1, 2010.

Literature review and theoretical developments on governing fish chains

The theoretical approaches to understanding the biological and economic interactions of the fishing industry have evolved from a static Gordon-Schaefer bioeconomic model (Gordon 1954; Schaefer 1954), to include dynamic optimized models and multispecies approaches (Clark 2006). This theoretical review and developments are relevant to understanding rebuilding challenges and opportunities as the biological and economic disciplines have had a long-standing influence on fisheries management and policy.

The key contribution of the fishery bioeconomic model lies in its ability to assist in predicting resource use strategies and net economic benefits through time. The Gordon-Schaefer model assumes that annual total cost (TC) is proportional to fishing effort (E) and that annual total revenue (TR) is also assumed to be proportional to annual catch or yield (Y). The maximum sustainable yield (MSY), as shown in Figure 1 (left hand side), is a conservation reference point in fisheries management and fundamental in setting harvest rates and rebuilding targets. The bioeconomic model predicts that in a common pool unregulated or poorly managed fishery, E will increase to a point where TC equals TR, referred to as bionomic equilibrium (BE), where rents are totally dissipated. The sustainable resource rent from the fishery is the difference between TR and TC. (Clark 1990). As shown in Figure 1 (left hand side), increasing fishing effort beyond E_2 at the MSY level will lead to both economic and biological overfishing. It is argued that lower fishing effort below MSY such as at E_1 provides higher rents at MEY and also promotes conservation goals. In addition, harvesting at a higher rate than the natural growth or replenishment rate would lead to overfishing and stock collapse. Therefore, sustaining the resource and maintaining profits in the longer-term implies keeping harvest rates at levels such that the growth rate is higher than the harvesting rate.

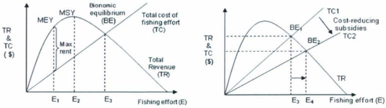

Figure 1: Static Gordon-Schaefer bioeconomic model of fisheries (Gordon, 1954)

Similarly, the provision of fishing subsidies from governments to the fishing industry especially in capital-intensive fisheries will lead to higher participation and increases fishing effort from E_3 to E_4 as shown in Figure 1 (right hand side). This corresponds to a shift from BE_1 to BE_2 thus leading to further negative consequences for resource sustainability and economic viability.

Copes (1970) built upon this theoretical model to incorporate a decision-making component within the context of supply and demand, and potential externalities to the environment. Economic theory predicts that changes in demand and supply will affect the quantity produced and hence shift the equilibrium price, assuming that the product is not easily substituted and that price is elastic. As shown in Figure 2 (left hand side), as fishing increases because of high demand from D_1 to D_2, the quantity produced will first increase from Q_1 up to the MSY level, and then decline to Q_2, with corresponding changes in price from P_1 to P_2. In this context, the long-run supply curve for fisheries may be backward bending owing to the biological constraints on growth and reproduction, and the common pool nature of fisheries (Copes 1970). This is due to the social-ecological nature of fishery systems which are highly susceptible to both human-induced and natural shocks and uncertainties (Smith *et al.*, 2010). This scenario is unique to seafood production compared to agri-commodities, because of their common pool nature and, in some cases, their highly migratory behavior.

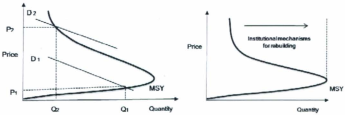

Figure 2: Backward bending fish supply chains (adapted from Copes, 1970)

In theory, fish supply chains in well governed fisheries should not be backward bending, as fishing effort will be regulated and monitored relative to natural growth rates. Copes (1970) suggested several institutional mechanisms that could be used to avoid collapse and the dissipation of economic rent; including restricting fishing effort, raising taxes, as well as using marketing initiatives to deal with price fluctuations and product substitution. Institutional mechanisms and support for rebuilding initiatives are thus essential to restore resource supply to its previous MSY level as shown in Figure 2 (right hand side).

These bioeconomic considerations are essential for both theoretical development and methodological approaches towards rebuilding. In addition, fish stocks, like many other renewable natural resources, are regarded as natural capital that is capable of yielding a stream of benefits to society through time (Munro and Sumaila, 2002). 'Investments' in natural capital such as stewardship and institutional mechanisms for better management and compliance can lead to sustained economic returns. 'Disinvestment' in natural capital through activities such as overfishing or high-grading can affect resource sustainability and lead to collapse and economic loss (Sumaila *et al.,* 2010a). Furthermore, improvements in fishing technology during periods of collapse may lead to an increase in 'catchability', thus allowing fleets to target vulnerable discrete remaining stocks thereby limiting early recovery (Mackinson *et al.,* 1997).

In addition, varying discount rates affect the level of investments in natural capital, with recent research recommending greater attention to intergenerational considerations (Sumaila and Walters, 2005). High discount rates and unregulated access signify support for immediate benefits over future gains. This affects the effectiveness of conservation policies, especially for long-lived species with low intrinsic growth rates. However, rebuilding policies that place emphasis on long-term benefits at the expense of short term gains are often opposed by the fishing industry. For example, quota reduction has been resisted in several rebuilding efforts in New Zealand (Clark 2006), as well as in Canada and the US (Khan and Neis, 2010). Low discount rates and regulated access have been major policy measures used to promote the conservation of many long-lived species, especially groundfisheries and whale populations (Clark, 1990). Conservative discount rates also provide incentives to invest in fisheries rebuilding as bigger fish sizes and species abundance could yield higher profits (Grafton *et al.,* 2007; Asche and Smith, 2010). Size and abundance are not the only factors that affect profits; value-addition could play a key role in revenue generation (van der Schans *et al.,* 1999).

Both supply and seafood value chains involve numerous institutions, stakeholder groups, diverse species and product types with the potential to affect rebuilding and economic viability (FAO 2010b). Supply chains for seafood are among the most complex and dynamic of food chains (Bavinck *et al.,* 2005). Their complexity increases as the scale of seafood production and trade becomes global in scope (UNEP 2009; FAO 2010b). On-going efforts and initiatives to sustain global seafood trade have involved many partnerships and collaborations amongst stakeholder groups and institutions. These include the promotion of corporate social and ecological responsibility through sustainable fishing practices, fair trade rules, quality control, and chain of custody rules. Some of these institutional mechanisms have greatly influenced fisheries sustainability through seafood trade policies, eco-certification, and potential price premiums (Smith *et al.,* 2010). Although there are emerging discussions on market power (Anderson, 2008), regulatory capture and lobbying power (Sutinen, 2008), in addition to consumer buying power (Guillen, 2010); little research has been done on power relations along fish chains and their potential role in rebuilding fisheries (see Chapter V).

Power relations and the political economy of seafood trade have been a topic of debate due to the current status of global fish stocks, the persistence of trade distorting and capacity enhancing subsidies, human welfare issues, and tariffs and other trade barriers (Sumaila *et al.,* 2007; Nielsen 2009; Ashe and Smith 2010). Efforts to understand consumer choice and eco-certification schemes are all necessary for designing institutional mechanisms for sustainable seafood trade (Wessells *et al.,* 2001). Traceability and mislabeling (Jacquet and Pauly 2008), IUU fishing, and high seas biodiversity concerns have been shown to affect resource sustainability and economic returns (Sumaila *et al.,* 2010b). These concerns have led to calls for ecosystem-based approaches and adaptive management that acknowledge uncertainties and risks in fishery systems (FAO, 1995; Charles 1998; Armitage *et al.,* 2009). In summary, the governing challenges involved in seafood production especially when attempting to rebuild collapsed fisheries necessitate a move towards holistic approaches that integrate ecosystem considerations and supply chain governance.

Methodology

Fish chain approach

As highlighted in Chapters II and III, the fish chain approach incorporates the linkages between marine ecosystems, raw material supply, economic viability, supply chain actors and the role of institutions (Bavinck *et al.,* 2005). The fish chain focuses on three production stages and their interactions: pre-harvest (marine ecosystems), harvest (fishing operations), and post-harvest (processing, retail, and consumption), as illustrated in Figure 3.

Figure 3: The fish chain showing linkages between production stages and the flow of goods and services (Bavinck *et al.*, 2005)

Fish chains for commercial species such as cod consist of multi-scale interlinkages and stakeholder interactions in the global seafood marketplace. The chain is not only horizontal in scope, but encompasses vertical inter-linkages through key actors, social networks and policy instruments. The analytical framework integrates ecosystem-based approaches and institutional mechanisms through a suite of instruments that shape stakeholder strategies and consumer behavior for successful governing outcomes (Kooiman *et al.,* 2005; Thorpe *et al.,* 2005). These instruments include, amongst others, conservation measures, fishing regulations, international agreements, subsidies, taxes, voluntary measures, access rights, consumer awareness and information measures.

External factors such as trade liberalization and globalization may affect various aspects of the fish chain and affect rebuilding. Additionally, the options for policy changes along the fish chain are mediated by historical context such as institutions, power relations, leadership, innovation and decision-making strategies. The next section provides a market analysis of Northern Gulf cod production, emphasizing how raw material access, economic viability, supply chain organization and institutional mechanisms have affected rebuilding prospects.

Seafood market analysis

A seafood market analysis was conducted for both the pre- and post-collapse periods for the Northern Gulf cod and related fisheries in western Newfoundland. The analysis examines trends in landings, data on costs and earnings by fleet types, trade flows across international markets, supply chain organization, and institutional mechanisms for rebuilding collapsed fisheries. The analysis aims to determine factors that have and are affecting economic viability and rebuilding prospects in this region; focusing on the harvest and post-harvest stages of the Northern Gulf cod fish chain. It also seeks to understand key drivers affecting harvest rates and resource supply, processing requirements and consumer markets for various seafood products. Unlike most seafood market analysis that focuses on both investment and profitability for firms (Moore *et al.,* 1993; KPMG 2004), or costs and earnings for individual boat owners and fleets (DFO, 1985, 2007a), the approach in this chapter combines both financial and economic considerations.

For the first step of this seafood market analysis, an archival and document analysis was undertaken drawing on existing documents, policy and legal statutes, statistical information on landings and value, seafood market reports, scientific research on stock status, and government commissioned reports on fishing policy. The review and synthesis focused on trends in fish landings, information on predator-prey relationships, price and landed value, fleet operations, policy changes, costs and earnings, price-setting mechanisms, consumer preference, retail markets, and trade flows.

The second phase of the research involved a set of semi-structured interviews with fifty key informants from diverse stakeholders groups located along the fish chain. Unlike other research techniques that rely on statistical or econometric analysis (e.g. Roy *et al.*, 2009), the key informant interviews in this study focused on understanding stakeholders' perceptions of policy processes, marketing opportunities, organizational and decision-making approaches relevant to rebuilding. The interviewees were identified through the literature and document analysis, as well as through snow-ball sampling techniques with stakeholders along the fish chain.

The interview questions focused on several key issues associated with the harvest and post-harvest stages of the fish chain. Notably raw material access, allocation measures, spatial scale of organizations, harvesting and processing policies, marketing chains, distributional networks, and institutional mechanisms. The key informants included six main groups of stakeholders with each key informant having a minimum of 20 years experience within the fishery to ensure adequate knowledge of the fishery prior to and after the collapse. These groups included: seven scientists and fisheries managers; twelve fish harvesters; eight entrepreneurs engaged in the processing and retail sectors; seven municipal and community planners; ten bureaucrats and other decision-makers at different organizational levels including within the federal and provincial governments, industry, and inter-governmental organizations; and six research analysts from the consulting, academic, and the media. The results include quantitative and statistical data gathered from scientific research and trade reports, in addition to insightful accounts from key informants along the fish chain on developments, opportunities, and challenges for rebuilding in the harvesting, processing and marketing portions of the fish chain.

Findings

The findings on the changes in the marketing stages of the Northern Gulf fish chain (harvest and post-harvest stages) are provided in four sections to illustrate rebuilding challenges and opportunities. These include: i) changes in raw material access; ii) changes in the marketing chain regarding supply chain organization; iii) changes in the marketing chain regarding economic viability; and v) institutional changes and policy options.

Changes in raw material access pre- and post-collapse

The current total allowable catch for Northern Gulf cod stocks is 2,000 tonnes, which is 2% of the historical maximum attained in the early 1980s. A pre- and post-collapse analysis of stock assessment data, ecosystem models, and policy documents revealed ecological constraints for cod population viability and raw material access in the post-collapse periods (Morissette *et al.*, 2009; DFO 2010b). These ecological constraints were corroborated by key informants who identified the following key concerns for resource abundance and raw material access: i) on-going fishing activities for cod and other small pelagics such as capelin on which cod feeds; ii) increasing natural mortality due to predation from seals; iii) seismic activities in the gulf that might affect cod habitat and population viability; iv) concerns about by-catch and discard rates from other fisheries such as turbot; and v) institutional inertia and poor stewardship incentives for cod rebuilding.

The cod stocks have failed to rebuild and are currently assessed below conservation limit reference points (DFO 2010b). As discussed in Chapter III, the lack of institutional mechanisms for decision control rules and rebuilding targets for collapsed stocks have the potential to exacerbate rebuilding timeframes. These shortcomings are not well-communicated to stakeholder groups and are essential for public acceptance and buy-in especially on conservation measures and lower TACs. Regarding stewardship initiatives for stock rebuilding and resource access, some key informants mostly fish harvesters in the 3Pn region identified policy measures that have been implemented to protect spawning as well as juvenile cod. Most of the fish harvesters interviewed on the southwest coast recommended using only hook and line gear for fishing groundfish as practiced in the 3Pn region, in addition to initiatives such as a seasonal closure of cod spawning area in Bay St. Georges.

In the pre-collapse period, technological development and increasing fishing effort in the face of ineffective fisheries management in addition to capacity enhancing subsidies to offshore dragger fleets have been cited as having contributed to the collapse (Sinclair, 1986; Palmer and Sinclair, 1997). Current predation rates on cod especially by seals, on-going commercial and recreational fishing activities, and potential ecosystem shifts have been identified to affect Northern cod rebuilding (Rice *et al.*, 2003; Savenkoff *et al.*, 2007; Morissette *et al.*, 2009). With stalled rebuilding and livelihood concerns in the post-collapse period, Northern Gulf fishing activities have shifted focus to invertebrate species, mostly shrimp and crab, as shown through recorded landings in Figure 4.

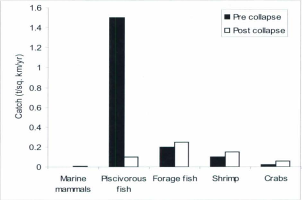

Figure 4: Changes in catch rates for major fish groups in Northern Gulf region (source: Savenkoff *et al.*, 2007)

These changes in target species have affected the organization and distribution of processing infrastructure and been associated with new consumer markets for shellfish. The higher production value for shellfisheries raises concerns for backward bending supply implications, especially in the absence of institutional mandate to stop overfishing and to rebuild fisheries. There are emerging signs of poor resource supply and environmental changes that resulted in one voluntary crab closure in western Newfoundland (DFO, 2009)[16]. This stewardship initiative in snow crab management area 12G spanning from Cape St. Gregory to Broom Point was initiated by fishers because of poor stock status, and supported by the union and the Department of Fisheries and Oceans for two years' closure. There have also been reductions in TACs in several other NAFO management regions for shrimp and crab stocks in the province (DFO 2008b), with equity and allocation implications especially for the inshore fishers (Schrank 2005). Further rebuilding concerns about changes in target species, especially for forage fish such as capelin, were articulated by several key informants. According to a community planner in the Corner Brook region: "I can't see how stocks can recover when we are still fishing capelin and other stuff, how can the fishery recover when we are destroying the very foundation for the fishery".

Furthermore, some fish harvesters in the 4R and 3Pn regions in Newfoundland raised concerns about the small cod they were catching and the corresponding poor prices they had received from fish processors. A fish harvester explained the relationship between price and size: "when the fish is small, we get 0.50 CAD for 16-20" and greater than 20" the price hikes up to 0.62 CAD". The difference in price, particularly in the 4RS region where gillnets are used raised concerns about discarding and 'high grading' of small sized fish and concerns about recruitment overfishing. Management measures for by-catch restrictions vary by gear and species targeted in the Gulf of St. Lawrence. For instance, gillnets for cod fishing have high by-catch restrictions in NAFO region 4R and strict penalties on voluntary landings. However, in NAFO region 3Pn in South-western Newfoundland where hook and line is the only fishing gear allowed for groundfish, the maximum percentage of by-catch permitted is 20% for American Plaice and White Hake, and 10% for Greenland Halibut as stated in the 2008 DFO-FFAW harvest plan. To

[16] Western Shorefast Newsletter, Spring 2009: http://www.curra.ca/documents/CURRA%20Newsletter%20-%20Spring%202009.pdf accessed June 2, 2010.

deal with issues of discarding, I asked some fish harvesters how to deal with these challenges. They suggested mechanisms to permit trading of by-catch in meeting their quotas, and compulsory or voluntary disclosures as practiced in countries such as Norway. These proposed measures are arguably necessary for compliance, sustaining the resource, and for accurate reporting.

Changes in the marketing chain pre- and post-collapse: Supply chain organization

A review of market reports, in addition to key informant responses, illustrates that the cod supply chain was much longer and producer-driven in the pre-collapse period. In this era, cod chains were characterized by high production volume of mainly cod blocks primarily targeting the US market. These supply chains entailed primary and secondary processing components, domestic and international, as well as wholesale and retail outlets as shown in Figure 5.

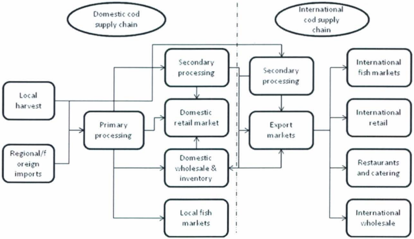

Figure 5: Pre-collapse cod marketing and distribution networks to US and foreign markets

Three US market segments were dominant during this producer-driven era: white table cloth restaurants and fast food joints; cafeteria food services; and retail grocery fish stores (Kirby 1982; Wright 2001). The current operational range of the post-collapse cod fish chain is shorter and characterized by poor resource supply due to a lower TAC and cod is predominantly being sold as fillets. Most of the supply chain for cod processing has been restructured to meet fleet capacity reduction programs and corresponding whole sale operations. There have been limits on new licenses for primary processing and a further freeze on secondary processing licenses.

The current markets are mostly retail-based involving less chain actors and targeting high end supermarkets or niche markets in the UK and US. Total production volume has drastically reduced, with about 39,000 tonnes of groundfisheries landed in NL in 2010, and cod constituted only 24%. The total landed value for the groundfisheries in 2010 was about 50 million CAD according to the 2011 Annual Seafood Industry Review. Key informants in the processing and marketing sectors highlighted numerous changes in the cod fish chain from a producer-driven chain to a more consumer-driven chain that produces high value cod fillets for niche markets and local consumption. Alaskan Pollock (*P. polachius*), New Zealand Hoki (*Macruronus novaezelandiae*), Icelandic and Norwegian cod (*Gadus morhua*) have replaced NL cod in the global markets in the post-collapse period (O'Reilly 1993). In addition to Pollock, other whitefish such as hake (*Merluccius spp*) and tilapia (*Tilapia spp*) have taken up about 75% of the US market share since 2005, with imports doubling from USD 150 million in early 1990 to USD 300 million in late 2000 (Asche and Smith, 2010).

Furthermore, for most local fishers who have remained in the fishery, the more lucrative shellfishery is a better option due to its higher landed price and production value. According to the 2010 Seafood Industry Review, shellfisheries accounted for 60% of total landings and generated 84% of the total landed value (369 million CAD). In a discussion with a key informant about the recovery potential of cod, he remarked that cod is now a nuisance, because of its low landed price relative to shellfisheries:

> [If cod were to come back]…you are going to have to manage it in a very different way than we used to. We have to come up with a new concept. Ok, who fishes that cod? The cod right now is a nuisance, because it's a nuisance in by-catch, too much by-catch. This guy is fishing turbot [higher landed value], but he can't fish it because of all the [juvenile] cod. The other thing is, he is looking at cod as a predator of small shrimp and crab [higher landed value], and right now they've spent tens of thousands in changing from cod to shrimp and crab fishery. They don't want to go back to cod; *right now cod is a nuisance* [emphasis added].

Equally important, these changes in target species affect consumer markets. Seafood exports have shifted towards shellfisheries that target global seafood markets to the EU, US and Asia, and away from the predominant US market (DFO 2008a). These changes in consumer markets and seafood prices have ramifications for transition costs and buy-in from industry stakeholder groups. As explained by one key informant, a fish processor and exporter:

> [There would be a] huge impact if the groundfisheries were to come back. Shrimp production is highly computerized [mechanized]. If groundfish recovers now, the union [FFAW] would say, how could you restructure all the debt, from crab to groundfish? There will never be groundfish at 2.47 CAD a pound [price for crab]…If we have groundfish recovery of large volumes; the challenge would be the market place is not strong. We don't have the labour force if the groundfish were to come back…When cod comes back, crab, I'd say we have 2 or 3 years left of shrimp, it will be gone...

Apart from predator-prey and ecosystem concerns if cod rebuilds, key informants identified a potential supply glut during the summer months that could affect profitability. According to one processor, cod fish caught in summer in places such as western Newfoundland (4R) are on their feeding migration and full of capelin. Catching fish at this time affects processing quality and the sale price in the market place. These mismatches between the cod harvesting season, quality and market demand often led to 'distress selling' in the past because of inventory costs (Kirby 1982).

Suggestions for future marketing options from stakeholders included more direct wharf sales to local consumers and in tourist niche markets in the summer. The formation of cooperatives was proposed by harvesters for high end sales as formerly practiced in Petty Harbor and Fogo Island in Newfoundland. Other examples across Canada include the community supported fishery in Nova Scotia (Off the Hook), a local fishery that promotes 'short fish chains' by directly selling to consumers, sustainably harvested by gear friendly nets, and supports local fishing entrepreneurs directly without processors and middlemen. Other suggestions from stakeholders in the fishing industry specifically fish harvesters, included fish auctions and direct bidding as practiced in Japan and Iceland. Secondary processing, product differentiation, branding and eco-certification were mentioned as future opportunities, considering the role of third party labeling initiatives such as the Marine Stewardship Certification (MSC).

MSC certification is a voluntary stewardship scheme that often involves a third party to evaluate and assess sustainability along the fish chain using chain of custody rules. Created in 1996 by World Wildlife Fund for Nature, and Unilever (the largest fisheries buyer and processor at that time), it is the major global certifier for wild capture fisheries (Gulbrandsen, 2009). Other examples of seafood eco-certification and traceability initiatives include Friends of the Sea, Thisfish, and the Marine Aquarium Council. The growing reliance on eco-certification as a policy instrument is partly attributed to the globalised nature of food production and the buying power of consumers (Stringer and Le Heron, 2008; Swartz *et al.,* 2010). The programs have been partly successful because of consumer awareness campaigns from conservation groups and commitments from retail marketing chains in Canada and abroad (such as Unilever, Wal-Mart, Sainsbury, Marks and Spencer, Loblaw, and Carrefour). Generally, eco-certification focuses on key sustainability criteria along the fish chain including healthy fisheries ecosystems, effective management, compliance to regulations, and consumer awareness on seafood production (Gulbrandsen, 2009). Critics have argued that these criteria are insufficient, as they neglect social justice and equity issues, in addition to trade barriers for certain fisheries especially in the small scale sectors (UNEP 2010). Due to the high level of institutional collaboration required, eco-certification process raises questions about the credibility of the fisheries assessment, the potential costs and benefits to local economies, and its effectiveness in the long term (Jacquet *et al.,* 2010). Moreover, the cost of eco-certification is sometimes too high to afford by certain stakeholder groups, in addition to the duration of the assessment process, and other political economy issues (Ponte, 2007). These challenges pose new dilemma for fisheries managers and the fishing industry. To date, about 268 fisheries are engaged in the MSC certification program, with about half certified and another half under assessment[17].

Out of the 130 fisheries that have been certified by the MSC around the world, only 18 are found in Canada, with several others under assessment (OAG, 2011). In Newfoundland and Labrador, two fisheries have been certified by the MSC – the Fogo Island Cooperative and the Association of Seafood Producers, both harvesting the Northern Shrimp (*Pandalus borealis*). This shrimp fishery uses otter trawler vessels under 65 feet, that are owner-operator, has full observer coverage and the fleets are required to use the Nordmore grate system to reduce by-catch and prevent habitat damage.

[17] http://www.msc.org/business-support/key-facts-about-msc last accessed December 10th 2011

Because of the huge investments in shellfisheries processing infrastructure and in eco-certification schemes, there are concerns about the implication of cod rebuilding on ecosystem structure and its potential impact on the lucrative shellfish trade.

Changes in the marketing chain pre- and post-collapse: Economic viability

The economic viability of the fishing industry (harvesting and processing sectors) is assessed in terms of operational profits, which depend on total revenue in relation to total costs. The cost structure of fishing operations varies by type of fishing enterprises, capital investments, and fleet types, as well as the number and types of fishing licenses. Fishing costs can further be divided into fixed or sunk cost, and variable cost.

Interviews with inshore harvesters reveal mixed responses on the viability of fishing enterprises in the post-collapse period. According to one fisher:

> I don't like the way the fishery is going bye. The fishery is going belly up for the small [scale] man. I think if you can afford to be there, you are going to be there. And if you can't afford to be there, if you can't afford to spend thirty, forty thousand dollars a year, you aren't going to stay into the fishery. I'll be paying off credit card payments until fishing next spring to pay off what I spent in to it this year…I haven't broke even in the last four or five years….

Other inshore harvesters interviewed, however, seemed to have viable enterprises. This is primarily due to access to multiple quotas and licenses for lobsters, crab, shrimp, halibut, capelin, and herring. Those who have numerous licenses have better economic performance of current fishing operations. According to the 2006 *Costs and Earnings Survey*, net income for medium sized vessels in the 35-60' category with multiple fishing licenses for cod and other pelagics was about 97,000 CAD before taxes, with total fishing revenues estimated at 292,000

CAD for the gulf region (DFO 2007a). For smaller vessels less than 25', total revenue was about 27,000 CAD, operating and maintenance costs were estimated at 17,000 CAD and net income at about 7,000 CAD before taxes and not including income from Employment Insurance (DFO 2007a). Furthermore, the financial performance of enterprises engaged in shellfisheries is higher for combined crab and shrimp enterprises in the 35-64' vessel category, than for groundfisheries in the same vessel category.

The DFO (2007a) *Costs and Earnings Survey* did not take into account debts and seasonal unemployment benefits. Key informants identified indebtedness as the biggest challenge in the fishing industry. One key informant, a research analyst, explained: "Debt, it's our biggest problem, the capital we've used in this industry, its huge" referring to issues of 'capital stuffing' and investment in fish finding devices and technological improvements.

The types of fishing licenses and fishing enterprise determine crew profits and revenue sharing mechanisms. Although crew sharing arrangements vary from one enterprise to another, there are some indications that a more equitable crew-sharing ethic was adhered to in the pre-collapse era (DFO 1985). In the post-collapse period, Schrank (2005) documented higher owner shares for skippers sometimes in excess of 100,000 CAD per year; whilst crew members received about 22,000 CAD of which 45% was income from Employment Insurance. As highlighted by one key informant, the change in revenue sharing mechanisms appears to have affected labour markets including particularly the retention of skilled workers in fishing communities and the human capacity to deal with rebuilding challenges.

In the pre-collapse era for the processing sector, larger plants with multispecies licenses mainly for groundfisheries, pelagics, and shellfisheries were economically more successful than smaller plants with few licenses (Kirby 1982; Moore *et al.,* 1993). Key informants identified the former Fishery Products International and National Sea Products (High liner) as more successful in acquiring global market share because of stronger marketing strategies and state support. In the post-collapse era, these bigger companies sought to keep their market share by importing groundfish from the Barents Sea to keep their processing operations going in till the early part of 2000 (Dean, 2001; Schrank 2005).

Regarding individuals and fishing households in coastal communities in the Northern Peninsula, about 50% of livelihoods in the harvesting and processing sectors have been lost due to the collapse and restructuring measures as shown in Figure 5 in Chapter III. Out of the seventeen processing plants reported in the pre-collapse period in this region, only eight remained as of 2007 (GNPFT 2006). This pattern of changes in coastal livelihoods is similar to that in the province as a whole as shown in Figure 6, illustrating numerous closures in number and location of fish processing plants.

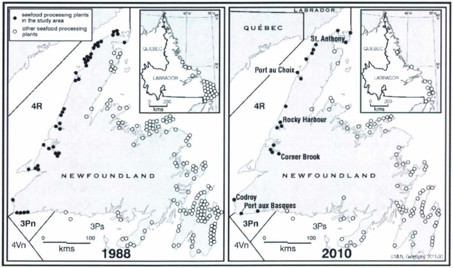

Figure 6: Number and location of fish processing plants pre- and post-collapse (Adapted from McManus, 1991 and Department of Fisheries and Aquaculture Annual Seafood Report 2010)

Currently, most of the secondary processing of groundfish including cod is done in low cost countries mainly in China and re-exported to Canada (DFO 2008a; FAO 2010). Key informants in the processing and harvesting sectors identified only one major cod processing plant and seafood exporter left in the province (located at Arnold's Cove), targeting mostly niche markets in the UK. Profits in groundfish processing in the post-collapse era are very low due to competition with cheap substitutes such as Pollock from Alaska and Tilapia from Asia, and consumer demand for certified and sustainable seafood products.

In the pre-collapse era, interest rates affected profitability, contributing significantly to a 16% decline in 1989 (Moore *et al.,* 1993). Key informants, predominantly industry stakeholders in the processing and retail sectors expressed concerns about the increasing parity of the Canadian dollar with the US dollar. One key informant, a medium scale processor illustrated this with an example:

> ... the Canadian dollar is up now. That got a reflection in the market place and that got a reflection on the price you pay to the fishermen. I went back about two weeks ago and looked at what the exchange rate was last year; it was 21 cents. Right now we're less than five. That's a big difference. You're looking at probably 18 cents difference on a pound of filets. That's a lot of money. Every hundred thousand pounds of filets is 18,000 dollars.

Because most of the Canadian exports are tied to the US, industry stakeholders are exploring other markets with stable currencies. In 2005, the US received about 66% of NL seafood products in terms of value (DFO 2008a) next to the EU (14%), followed by Japan (11%) and China (9%). This trend had changed by 2008, as the US dollar depreciated, the Euro remained stable, and China became a bigger player in seafood trade (Roche 2008). In 2008, the US and

China captured 32% and 23% of export markets by value, with Russia and Japan following at 7.5% each, the UK at 7% and Denmark at 5%[18]. These changing global markets and macroeconomic factors impact seafood trade, the viability of local fisheries, and cod recovery prospects especially with poor consideration for macroeconomic factors in rebuilding planning.

The Northern Gulf market chain for cod and related fisheries involved four to eight key stakeholders in both the pre- and post-collapse periods, depending on market destination and consumer preferences. The key stakeholders continue to include the fish harvester, buyer, processor, broker, distributor, wholesaler, retailer and final consumer. A fish buyer can also be a processor; however, most buyers lack primary processing licenses and truck their raw material to processors with primary or secondary licenses.

In the pre-collapse period, raw material in the form of cod landings contributed to about 62% of plant operating costs; next to labour and wages at 22%, energy at 3%, and profits assessed to be around 13% (Kirby 1982). Key informants in the processing sector mentioned that a similar cost structure was evident in the current cod fish chain but there has been an increase in packaging, distribution, and brokerage costs. In 2009, a pound of cod at dockside valued at 62 cents purchased from fish harvesters eventually cost about 6 to 8 CAD at the retail end of the chain (Figure 7).

Figure 7: Price and retail value across the marketing chain for cod fillet in the post-collapse period (Khan, 2010)

[18] Department of Fisheries and Aquaculture, Seafood Industry Year in Review: http://www.fishaq.gov.nl.ca/publications/annual_report08_09.pdf accessed May 6, 2010.

The cost structure for the processors would include the 'flesh cost' (which is 0.33% processing yield), as well as distribution costs.

The *Fishing Industry Collective Bargaining Act* of 1971 governs fish price setting between fish harvesters and processors in NL in both the pre- and post periods. Dockside fish price setting is one of several 'focal points' along the fish chain that requires cooperation and negotiation to avoid conflicts (see Schelling 1960). Following disputes in the early 1990s regarding the dockside price for shrimp, binding arbitration was put in place along with an amendment to institute a price setting panel (Vardy *et al.*, 1998). The Report on the Standing Fish Price-Setting Panel for 2008/09 on collective bargaining for fish prices showed that out of ten key species, agreement was reached for only five[19], with further court decisions to be made on the justification of the panel decisions.

According to key informants especially harvesters, the cost and benefits are not fairly distributed across the marketing chain and in setting fish prices. There are high levels of mistrust amongst stakeholders, mainly between fish harvesters and processors in negotiating fish prices. Fish harvesters are very concerned about the poor price they receive for their raw material compared to the retail store price they observe sometimes in their own communities. Some are opposed to the provincial law against selling directly to consumers or welcoming buyers from outside the province. A fish harvester in Port Aux Choix explained the fluctuating prices:

> We were getting in 1986; we got close to a dollar a pound. That was a good price. Here we are today, 24 years later, we got 37 cents this year…You can't do that right [?]. The price, it's hard to say, the world economy [is at a downturn], and you would expect less this year. We got to look at our expenses and that; I can't say what we should be getting.

[19] Standing Fish Price-Setting Panel Annual Report 2008/09: http://www.hrle.gov.nl.ca/fishpanel/pdf/FishPanelAnnualReport0809.pdf accessed May 4, 2010.

You look at the basics of it; we got to have at least 60 cents a pound to survive. Cod should be close to a dollar a pound. That's for good fish...

The market prices for cod block fluctuated around 0.90 CAD a pound in the 1980s and steadily increased to 1.25 CAD in 1988; followed by a sharp fall to less than 0.70 CAD in 1989 and gradually increased to a peak of 1.15 CAD in 1991 (O'Reilly, 1993). In the post-harvest period, the retail market price for fresh cod fillet has fluctuated from 5 to 8 CAD in the past five years, with periodic shortage especially in the winter months. The price for frozen cod from the local Sobeys retail store sells for 5 to 7 CAD for a pound in the summer of 2009, almost the same price for imported frozen cod from High Liner. Some Canadian companies such as High Liner outsource their secondary processing to Asia in order to boost their dividend and to recompense for the rising Canadian dollar[20].

To deal with the low prices received by fish harvesters, some key informants suggested policy changes to facilitate direct selling to buyers from out of the province or direct wharf sales to local residents. However, fish harvesters are by law not permitted to sell their fish directly to consumers in NL. The rationale for this policy is to ensure quality control through processing requirements, secure local processing jobs, and to ensure accurate catch reporting. The disagreements between harvesters and processors about price setting, and direct sales to either consumers or buyers outside of the province raise concerns along the marketing chain for collective action on marketing initiatives and value addition programs.

Institutional change and policy options

Seafood trade is important for export earnings, food security, and local livelihoods especially in NL. However, sustaining the benefits from seafood trade requires strong institutional

[20] High Liner Seafood Company news http://www.theglobeandmail.com/report-on-business/how-captain-high-liner-beat-the-dollar-odds/article1501362/singlepage/ last accessed August 15, 2011.

mechanisms across all three stages of the fish chain. Institutional innovation amongst stakeholders is crucial in strengthening stewardship and marketing policies for reversing the backward bending supply in the event of collapse, shown in Figure 2. Furthermore, institutional mechanisms are critical in avoiding path dependencies and exploring options for economic change (North 1990). Three main concerns were raised by key informants related to effective institutions for rebuilding and sustaining the Northern Gulf cod fisheries. These concerns included: i) issues of overcapacity and restructuring; ii) multispecies management strategies and marketing initiatives; and iii) rebuilding plans and implementation measures.

Despite several restructuring and social adjustment programs implemented after the collapse of the groundfisheries, and as outlined in Chapter III, the fishery is still considered overcapitalized by some research analysts (Schrank 2005; Clift and Team 2011). For those who hold this view, overcapacity is defined in terms of inputs of fishing effort relative to the resource abundance, measured in terms of capital investments, total revenues, and technological efficiency in both the harvesting and processing sectors (Asche 2008). The combined outcomes of overcapacity and poor resource supply amidst industry restructuring were raised by stakeholders as key challenges to be addressed in order for rebuilding to be successful. This is due to the high level of indebtedness and low economic viability, which act as obstacles for reducing TACs and other effective rebuilding strategies such as by-catch measures.

Key informants interviewed in both the harvesting and processing sectors showed interest in multispecies harvesting and processing options for economic viability. These suggestions were in response to by-catch and stewardship concerns, which could boost viable operations, through multispecies harvesting plans. Although there are interests amongst stakeholders in various marketing programs, efforts to establish a fish marketing council as recommended under the

Federal-Provincial Fishing Industry Renewal initiative were opposed by a majority of processors in the Province[21]. According to one small-scale processor who voted against the marketing council "the marketing is not for us, it is for the big processors to inventory their fish in the US". Despite these marginalization concerns, funding for a marketing council has been approved by both provincial and federal agencies[22], based on recommendations from a Memorandum of Understanding (MOU) report (Clift and Team, 2011). In the event that the marketing council initiative goes as planned, it may create legitimate concerns for the smaller processors who opposed it. Moreover, because the MOU report did not adequately address cod rebuilding and its marketing challenges, it poses concerns in the light of eco-certification, chain of custody rules, and for environmental groups that promote sustainable seafood. These on-going conflicts between small-scale versus large-scale processors, inshore versus offshore fleets, and groundfisheries versus shellfisheries producers demonstrate that rebuilding problems are complex and linked to institutional change, power, and participatory decision-making.

As argued in Chapter II, in addition to market valuation techniques for consumptive goods such as fish and seafood in rebuilding planning, non-market valuation for ecosystem services is also essential (Sumaila and Suatoni, 2006). One of the biggest concerns identified by some stakeholders in the conservation community is that the assessment and decisions made by the Committee on Status of Endangered Wildlife in Canada (COSEWIC) charged with assessing vulnerable stocks do not take into consideration non- market valuation, discount rates, and long-term intergenerational and societal needs. A conservation biologist who is familiar with COSEWIC and the DFO's vulnerability assessment process commented on these shortcomings:

[21] Department of Fisheries and Aquaculture Press Release: http://www.releases.gov.nl.ca/releases/2009/fishaq/0212n06.htm accessed May 4, 2010.
[22] Provincial Department of Fisheries and Aquaculture Press Release: http://www.releases.gov.nl.ca/releases/2011/fishaq/0718n03.htm accessed August 19, 2011

> DFO currently does economic analysis, and they aren't very good. I don't think they should do them because they are inherently biased. That is exactly what harvesters need to know - the short and long term ramifications...if we close this fishery; this is how much lost income would be. If we go through some short term economic difficulties, we are anticipating the fishery will go from here to there, and this is how much more money it would be worth. I think that information is important but it's not communicated at all. DFO is sadly biased towards the industry…basically on the Species at Risk; the decisions do not take in to account the societal benefit of listing, [and] don't account for something called non use or market value. These species have value to these people, and they are willing to increase taxes or whatever, to keep these species intact.

In dealing with intergenerational equity concerns and industry participation, Sumaila and Dominguez-Torreiro (2010) have suggested governance approaches that improve the legitimacy for buy-in from resource users and reduction in transaction cost for managers. Such governance approaches could improve compliance and stewardship and support long-term benefits.

Discussion

The theoretical review and empirical findings from this research along the Northern Gulf cod marketing chain illustrates several reasons for stalled rebuilding and on-going poor economic viability in many Northern Gulf fisheries. Achieving sustainability and rebuilding stocks require paying attention to both biological and socioeconomic factors, as well as institutional mechanisms across the fish chain; rather than focusing on only one piece of the chain (see Sumaila 2002). The case study illustrates that paying attention to these factors could support rebuilding of fish stocks and fishery communities; but only if effective institutional mechanisms are put in place to promote conservation, sustainable harvesting practices, livelihood and food security considerations, and globalised seafood trade.

As discussed in Chapter III, the high level of fishing beyond sustainable levels, non-compliance to TACs, unsustainable fishing practices, and poor institutional responses not only contributed to stock collapse, but have led to stalled rebuilding. Other problems in the pre-collapse period related to illegal, unreported and unregulated fishing and 'under the tables sales' exacerbated catch statistics for stock assessment projections especially as they relate to future harvest rates and setting TACs (Palmer and Sinclair, 1997). In the post-collapse period, institutional changes such as dockside monitoring and other policy measures have reduced these potential external threats to the resource and improved shared stewardship in management.

Changes in target species from groundfish stocks to shellfisheries and pelagics and growing seal populations raise concerns about changing predator-prey relationships and by-catch issues that may be affecting cod rebuilding. These interactions in the harvest and post-harvest stages demonstrate that rebuilding goes beyond single species management and reactive restructuring measures to include attention to multispecies and ecosystem considerations, global seafood market dynamics, regional and community-level concerns, and equity.

As discussed in the theoretical review, rebuilding the resource and maintaining higher profits in the long term implies the need to keep harvest rates at low levels to avoid the ongoing problems of growth and recruitment overfishing. Increase in natural and fishing mortalities due to high predation rates, on-going fishing activities, and high dependency on the fishery appear to have prolonged stock rebuilding especially in the absence of stakeholder buy-in and effective institutional mandates for conservation measures. The theoretical arguments about the backward bending nature of fish chains, and empirical findings demonstrate that institutional mechanisms are central to avoiding overfishing, as well as to promoting compliance and stewardship required for successful rebuilding and viable fisheries. Better management practices and innovation are crucial in strengthening stewardship ethics and to reversing the backward bending supply in the event of collapse as shown in Figure 2. Recent institutional partnerships and efforts towards eco-certification initiatives for consumer awareness, corporate social responsibility, and for encouraging sustainable harvesting policies through chain of custody rules for seafood trade are proving to be effective policy instruments for viable and sustainable fisheries. Although eco-certification has its shortcomings (Jacquet and Pauly, 2008; Gulbrandsen, 2009), it nonetheless provides opportunities for non-state actors (especially consumers and the fishing industry) to contribute to sustainability practices and behavioral policy changes.

Key informants recommended policy coherence between the harvesting, processing and marketing sectors; as well as institutional partnerships on price setting and value addition. The analyses further suggest that a closer interaction between the fishing and processing sectors may influence stakeholder partnerships and marketing initiatives; recognizing changes in global markets, macroeconomic factors, foreign competition, and the significance of value-addition.

In addition to transformative initiatives amongst stakeholders during rebuilding transitions and beyond (see Gilcich *et al.,* 2010), institutional mechanisms are also critical in avoiding path dependencies and enhancing economic performance (North 1990). One key informant, a retired civil servant, pinpointed to the relevance of legislative mandate and institutional mechanisms towards successful rebuilding:

> …we've learned next to nothing since the collapse….all I know is that our existing legislation is inadequate…The Americans have had success, and what I like about it, everybody knows what the objectives and timelines are. It has to be taken out of the

> political hands. Our current system is terrible with the amount of input the industry has. The Minister of Fisheries and Oceans is looking at the industry too intently…You can have science wanting to close the fishery, minister was going to close it, [but] gets a call from the boys in Quebec, and what do you know, the fishery doesn't close. It will never go away unless we have some kind of legislation...

Drawing on the success of international examples for fisheries rebuilding such as in the US; appropriate policy instruments, legislative mandates, and governing arrangements that emphasize compliance and stewardship are central (Caddy and Agnew, 2005; Wakeford *et al.*, 2009). For example, the rebuilding success and viability of four commercial species in the US was due to three critical institutional mechanisms (Wakeford *et al.*, 2009). These include: (i) the 1973 Endangered Species Act, which deals specifically with conservation measures and recovery mandates, (ii) the 1996 Sustainable Fisheries Act and the reauthorized 2010 Magnuson-Stevens Act that deal with the rebuilding of collapsed fisheries to previous MSY levels, and (iii) regional fisheries management councils that coordinate with key stakeholders and community groups regarding policy development (Hanna 2010). Evidence from the North Sea cod fisheries rebuilding exemplify the potential benefits of taking an ecosystem approach and adhering to policy consensus with stakeholders for collective action (Gray *et al.,* 2008; Davis and Rangeley, 2010). These rebuilding efforts epitomize legal and institutional mandates, stewardship incentives, ecosystem considerations, as well as stakeholder partnerships in seafood production.

Conclusion

In this chapter, a fish chain approach is employed to understand pre- and post-collapse changes in the marketing chain for cod and related fisheries in the Northern Gulf of St. Lawrence. Drawing upon theoretical developments and the empirical findings, this multiple analyses demonstrate that in collapsed fisheries, marketing factors are central to resource sustainability and economic viability. Seafood is the most traded commodity globally; involving fish supply chains that are complex, dynamic, and spanning several administrative and jurisdictional scales.

Key findings indicate that the cod fish chain has transitioned from a producer-driven production model in the pre-collapse period that exports cod blocks to the US, to a consumer-driven production model in the post-collapse period that place emphasis on cod fillets and eco-certified products. The pre- and post-collapse analyses of Northern Gulf cod marketing chain further demonstrate the need to align policy instruments to changing ecosystems, resource supply, fleet and processing capacity, livelihoods, and consumer markets. These complex and multiple challenges are best addressed through effective institutional mechanisms that deter overfishing, support multispecies rebuilding approaches, pays attention to value-addition, and explores diverse policy options with stakeholder groups and local communities for both local and global seafood markets.

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Chapter V: A Fish Chain Analysis of Wicked Rebuilding Problems: Power and Governing Interactions in the Northern Gulf Cod Fisheries

Introduction[23]

Despite the longstanding concerns about failed fisheries management in Canada (Charles 1995; Hannesson 1996; Wappel 2005), and the growing literature on the role of fisheries governance (Kooiman *et al.*, 2005; Ommer *et al.*, 2007), fisheries management is still assumed to entail tame problems that can easily be fixed. A tame problem, following Rittell and Webber (1973), is one that is well defined, with clear objectives and solutions that are testable and applicable to other problems such as those seen in engineering and the natural sciences. Related to this, most management approaches for major commercial fisheries are hierarchical with centralized decision-making and frequent reliance on so-called 'fishfull thinking' (Pitcher and Lam, 2010), which includes 'band aids' (Hilborn *et al.,* 2004), 'technical fixes' (Degnbol *et al.,* 2006), and cure-all 'panaceas' (Ostrom *et al.,* 2007). This reliance on technical management measures has been described as similar to trying to 'paint a floor with a hammer' (Degnbol *et al.,* 2006), and has generally resulted in such management failures as overfishing, collapsed stocks and failed rebuilding.

In Chapter II we argued that in the Northern Gulf of St. Lawrence cod fisheries, as well as globally, there is a strong rebuilding imperative with ecological, social, equity and food security dimensions. Building on Jentoft and Chuenpagdee (2009), we argued that rebuilding collapsed fisheries poses a particularly wicked problem from the point of view of governance. With wicked fisheries and coastal governance problems, there is no definitive agreement on what the problem is, let alone on solutions. In fact defining the problem is also part of the problem

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because, from a governance point of view, the process of defining the problem often excludes key groups and options. Because wicked problems are place and context specific, and because there are often unintended and severe consequences from reactive fisheries management measures, there are no 'one size fits all solutions' to these problems. Moreover, there is limited space for failure and social experimentation because there is a high level of both perceived and real risk that can be difficult to anticipate because of the complexity and dynamics of social-ecological fishery systems. Rebuilding involves multiple spatio-temporal scales including tradeoffs between short-term losses and long-term benefits and between regional small-scale fisheries and global large-scale fisheries. Further, policy initiatives in one part of the fish chain will have consequences elsewhere. For example, the rebuilding of one species (for e.g. cod) impacts the abundance of others (such as shrimp or capelin), causing ripple effects within marine ecosystems and associated fishing activities and livelihoods. Similarly, past experience has shown that moratoria on fish stocks often create by-catch concerns and related discarding or high grading with negative consequences for stock rebuilding as discussed in Chapters III and IV.

As with other wicked problems, the capacity to rebuild a particular collapsed fishery is mediated by existing institutional structures and power relations. For instance, who loses the most from a stock collapse and who stands to gain most from the sacrifices required for rebuilding is affected to some degree by how the problem is defined and who is involved in decision making, both of which are related to power. The exclusion of key groups from decision-making can affect buy-in, compliance and stewardship, particularly in contexts where the legitimacy of science and management regimes have already been undermined by stock collapse (Finlayson, 1994). Chapter III of the thesis focuses on the pre-harvest and harvest stages of the fish chain assessing how post-collapse fisheries policy changes have constrained cod fisheries rebuilding prospects and threatened livelihoods in fishing dependent coastal communities. Chapter IV focuses on the harvest and post-harvest stages of the fish chain. It analyzes how changing seafood production and global markets have affected local rebuilding prospects and the long-term social and economic viability of the resource. This chapter revisits, once again, the wicked problem of rebuilding collapsed fisheries and the case of the Northern Gulf cod collapse and stalled rebuilding. Our focus here, however, is on the role of governing institutions and power relations in mediating options for solving the wicked problem of rebuilding collapsed stocks in this region and elsewhere. Specifically, this chapter explores how governing interactions vis-à-vis power brokerage, inclusiveness, and sharing of tasks and costs and benefits amongst stakeholders can both create wicked problems and, when changed, provide a means to resolve them.

According to Jentoft (2007), conceptualizing power has been an arduous task in the social sciences (see also Gaventa, 2006), especially as power influences many aspects of social relations from the household level, to the economy, industrial organizations, to institutional mandates, and the contributions of civil society associations. For example, market power in the form of monopoly and price control affects seafood trade and revenue generation and benefits to local communities (Dean 2001; Anderson 2008). Political and interventionist power have been identified as crucial in historical patterns of seafood trade and current supply chains (Swartz *et al.* 2010). Although there is a debate as to how producers and consumers influence power along supply chains and behavioral outcomes (FAO 2010), corporate social responsibility and consumer buying power are recognized worldwide as potential conservation tools through eco-labeling and chain of custody rules (Brownstein *et al.* 2003; UNEP 2009).

In the commodity and supply chain governance literature, power is analyzed by looking at four main indicators (Kaplinsky and Morris 2000): i) the relative bargaining power of stakeholders, ii) protection from competitors, iii) information control, and iv) revenue distribution and share of profits by stakeholders (see Gordon *et al.* 2011). While useful, this approach attends only to the market aspects of the fish chain and there is a need for an approach that could also track the relationship between power, institutions, stakeholder interactions, and ecological changes. Therefore, in this chapter, we utilize Gaventa's multidimensional approach to power, most recently presented as the 'power cube' (Gaventa 2006). This multidimensional approach aims to understand how shifts in power relations in time and space can contribute to fisheries collapses and also play a key role in rebuilding in the post-collapse period. Gaventa's (2006) approach to power goes beyond attention to traditional state management practices, to exploring opportunities and constraints on broader citizenry engagement for change, and is informed by governance thinking that is inclusive and participatory. This works well with a fisheries governance approach where governance is defined as "the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them" (Kooiman *et al.* 2005:17).

From a fisheries governance perspective, Jentoft and Chuenpagdee (2009) argue that, "[t]he process prescribed for wicked problems is one of interactive communication and learning amongst stakeholders, where norms and values are played out and where different ethics, ideologies, and epistemologies are active" (2009: 555). Because of diverse interests and values associated with fisheries resources, they argue for an argumentative approach that is inclusive of the collective judgments of stakeholders and contributes to making hard and soft choices. We draw on this insight and on the literature on clumsy solutions (Verweij and Thomson, 2006), to explore options for rebuilding collapsed fisheries taking into account social power and institutional innovation. The clumsy options incorporate insights from four fundamental perspectives on resource management problems; including individualism, egalitarianism, hierarchy, and fatalism (Rayner 2006). Individualist perspectives are based on rational choice arguments including those for privatization such as adopting individual transferable quotas (ITQ) within fisheries (Scott, 1996). Egalitarian perspectives are based on the underlying assumption that resources are common property and individuals can self-organize to manage their resources sustainably for the benefits of their communities (Ostrom, 1990). Those adhering to egalitarian perspectives within fisheries would tend to support community-based management approaches that place emphasis on the adjacency principle and on social justice for coastal communities (Jentoft *et al.,* 1998; Wiber *et al.,* 2004; Hernes *et al.,* 2005). The hierarchy perspective favors adopting a technocratic and top-down management approach to fisheries based on the assumption that only the state can effect change (Hannesson, 1996). Finally, fatalists tend to believe that irrespective of the approach that is pursued, crises in fisheries are inevitable with huge ecological, social and economic costs (Garcia and Grainger, 2005).

Clumsy solutions can, when conditions are right, spring out of policy dialogue amongst stakeholder groups with entrenched positions if supported by the creation of institutions appropriate for resolving wicked problems (Verweij *et al.,* 2006). A clumsy solutions framework works well with the governance approach to fisheries and coastal issues (Khan and Neis, 2010). In contrast to fisheries management, the focus of which is often on state agency and technical fixes, fisheries governance refers to the collective contributions of the state, the fishing industry and civil society for successful outcomes (Gray, 2005; Kooiman *et al.,* 2005). Consistent with a governance approach, in this chapter (as in earlier ones), we use a fish chain as an analytical framework to better understand the social-ecological interactions that have influenced rebuilding opportunities and outcomes from marine ecosystems to harvesting, processing and retail markets, as well as amongst stakeholders. While these production stages are highly interconnected through various stakeholder groups and actors pursuing social and economic activities at multiple spatial scales (Johnson *et al.,* 2005; Perry *et al.*, 2010), some actors may be dominant in one or more production stages depending on their level of influence and power (Mikalsen & Jentoft 2001). Power relations are thus an important aspect of governance as they can mediate outcomes through legal reforms or power brokerage and fostering resistance in the form of non-compliance or conflict.

The next section of this chapter provides a broader theoretical discussion of governance in rebuilding contexts focusing in particular on the essential role of power and equity challenges within fisheries in contributing to the wickedness of rebuilding. These also play an essential role in relation to the opportunities for clumsy solution options. Following a discussion of the methodological approach, the chapter then shifts to the Northern Gulf case study and does two things. First, it discusses, using insights from multiple sources, how institutional inertias and relations of power along the fish chain contributed to the collapse of the stocks and have mediated rebuilding options and outcomes showing that technical solutions and panaceas are not capable of resolving wicked rebuilding problems. Second, it uses the perspectives and thinking gathered in interviews with members of various stakeholder groups and other information sources to devise some examples of potential clumsy solutions appropriate for helping to achieve the rebuilding imperative in the Northern Gulf cod fisheries. The chapter concludes with challenges and opportunities for clumsy solutions and some examples on mediating rebuilding.

Theoretical framework

The capacity to protect, preserve and rebuild fisheries for current and future generations is mediated by social power within governing mechanisms and wider social relations (Cadigan 2004; Jentoft 2007). Although power and social relations amongst stakeholders are central to governance they are often intangible and difficult to assess and are largely ignored by fisheries managers. Moreover, power has received relatively little attention in research on governance for fisheries rebuilding, and policy processes often lack the mechanisms and conduit to deal with these challenges. Sinclair and Ommer (2006) define power as "the capacity to create (and to some degree control) an outcome of behavior" (Sinclair & Ommer 2006: 16). According to Gaventa (1980), power involves at least three dimensions. The first dimension refers to differences in the ability of individuals or groups to control outcomes through greater access to resources and bargaining positions. The second dimension of power relates to political processes or 'rules of the game' that create institutional settings that benefit certain groups by limiting access to decision-making arenas, thus permitting agenda setting and exclusion. The third dimension of power relates to the impact of power exercised through the first two dimensions on awareness or consciousness of an individual's or group's interests. Individuals or groups can fail to recognize their own interests and act contrary to them in contexts where limited resources, exclusion from decision-making arenas, and information management and other processes affect how they think and how they respond to these options. This relates to a fourth dimension of power, not incorporated in Gaventa's early model (1980) and relevant to rebuilding and clumsy solutions. It draws on Foucault's notion of 'fields of opportunity' (Foucault 2003; Macdonald *et al.,* 2006) and stems from the assumption that power is not monolithic and resistance to power signifies the multiple structures within which power is embedded (Foucault 2003; Sadan 2004).

Gaventa (2006) incorporates the 'fields of opportunity' dimension into his more recent iteration of power theory for which he uses the *power cube* heuristic device, as shown in Figure 1. The power cube is an analytical tool that researchers and activists can use to understand not only how to engage, but where and when to engage in order to increase the potential of achieving appropriate governing interactions such as those supportive of rebuilding. In this recent work Gaventa notes that "simply creating new institutional arrangements will not necessarily result in greater inclusion or pro-poor policy change. Rather, much depends on the nature of the power relations which surround and imbue these new, potentially more democratic spaces" (Gaventa 2006: 23). As shown in Figure 1, the cube consists of various levels, spaces, and forms of power dimension.

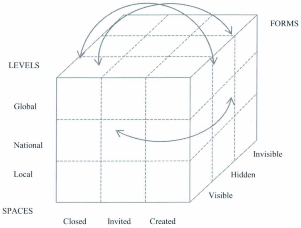

Figure 1: The 'power cube' showing the levels, spaces and forms of power (Gaventa 2006)

The levels can be global, national or local; the spaces can be closed, invited, claimed or created; and the various forms of power can be visible, hidden or invisible. Spaces are "opportunities, moments and channels where citizens can act to potentially affect policies, discourses, decisions and relationships that affect their lives and interests" (Gaventa 2005: 11). Following Cornwall

(2002), Gaventa argues that spaces are not neutral; rather, they are shaped by the power relations that surround them, set their boundaries and enter them. Spaces can be 'closed' as in certain bureaucratic processes, 'invited' as in stakeholder consultations or opinion polls, and 'created' as when community groups establish an informal forum for dialogue and discussion. Boundaries influence who can enter certain spaces and what identities, discourses and interests are acceptable within them. Power can also be seen "as the network of social boundaries that delimit fields of possible action" or fields of opportunity (Hayword 1998 as cited in Gaventa 2005).

Spaces for action can be found in multiple levels from local to global and, in the case of fisheries, we would argue, along any of the three production stages in the fish chain. Relevant local spaces for dialogue and engagement, or the blocking thereof, might be located within households, enterprises or municipalities; relevant national spaces might be found within company head offices or in national government departments; and relevant global spaces might include negotiating trade barriers. Within these place-embedded spaces, power can take many forms; it can sometimes be 'visible' as in the case of formal rules and institutional mechanisms. It can also be 'hidden' through political processes that allow for agenda setting and the exclusion of certain groups and issues as in the case of, for example, regulatory capture by powerful groups with substantial lobbying or corporate power. Lastly, power can be 'invisible' as can happen when it is part of "processes of socialization, culture and ideology" that "perpetuate exclusion and inequality by defining what is normal, acceptable, and safe" (Gaventa 2006: 29).

Understanding the interrelationship between the various forms, spaces, and levels of power can contribute to our ability to explain stock collapses and post-collapse rebuilding challenges. It could create better opportunities for change by combining all dimensions and helping us identify new spaces for strengthening institutional mechanisms and partnerships appropriate for rebuilding. Our recent documentation of the rebuilding imperative and exploration of some of the factors that have contributed to failed rebuilding of collapsed stocks points to the central role of power relations in those failures (Khan and Neis, 2010). In James Scott's critical analysis of why centralized state planning fails (exercising power in the first and second dimensions of Gaventa original model), he emphasizes that: "it [the state] always ignores essential features of any real, functioning social order" (Scott, 1998: 6). These overlooked aspects of space and place include community capacity, local knowledge, and local creative responses to decision-making. Some fisheries scholars have pointed to similar dynamics to explain institutional and state management failures in fisheries (Cochrane 2000; Jentoft 2004; Acheson 2006; Sutinen 2008).

Conversely, collapses and failed rebuilding can be attributed to various forms of power structures such as weak approaches to leadership on the part of the state and related agenda-setting by industry groups. In the US for instance, there are reports that access to decision-making platforms by industry groups through regional fisheries management organizations and lobbying expenditures to politicians have often tended to favor those who support on-going commercial fishing activities despite stock collapse and the need for conservation policies (Okey, 2003; Sutinen, 2008). Similarly in Newfoundland, early signs of stock recovery led to successful pressure from stakeholder groups (for instance, fish harvesters) to reopen the fisheries and increase quotas despite scientific advice for complete moratoria in several instances (Rice *et al.,* 2003; Best, 2009). Unequal access to resources and agenda-setting can work together to constrain not only who is at the table but also the space available for action, including what kinds of interests or discourses make it to the table, thereby shaping decision-making outcomes.

Debates about fisheries management and rebuilding that are limited to the concerns of government managers and that take place with particular industry segments often exclude not only other stakeholders (owners of bigger vessels, skippers versus crew, men and not women) but also their concerns, and can limit awareness of the full range of options available for rebuilding. These other stakeholders might include plant workers, coastal communities, conservation groups, youth, and the general public (see Lowe and Caruthers 2008; Wiber *et al.*, 2010). In addition, distributional and procedural equity concerns are paramount during rebuilding in particular for small-scale fishers and adjacent communities in the face of government funded restructuring programs that are top-down and often favor offshore mobile commercial fleets (Holland *et al.,* 1997; Woodrow 2003). Similarly, disciplinary silos and the exclusion of some disciplines and types of knowledge from fisheries management and rebuilding efforts can limit options. Issues of legitimacy, compliance and stewardship are strongly embedded in social capital and community networks that are often underrepresented in management science (see Jentoft *et al.,* 1998; Degnbol *et al*., 2004; Jentoft, 2004; Ostrom *et al.,* 2007). In contrast, knowledge synthesis and interdisciplinary scholarship that builds upon the social sciences can help overcome management failures and open up spaces for overall improved governance (McCay 2002).

As argued by Gaventa (1980), a historical approach to past experiences can help us distinguish between *quiescence* that is the result of power inequalities rather than shared interests by drawing our attention to what happens in the context of social change. When social change leads to a shift (temporary or permanent) in the balance of power, as often happens with collapsed fisheries, protests, social unrest and new institutions frequently emerge. These new institutions and engagement can change the consciousness of different stakeholder groups, lead them to formulate new strategies, and change the boundaries and spaces available to them to bring about change. For instance, the lack of scientific consensus on factors that contributed to stock collapse and industry's persistent refusal to acknowledge the effects of overfishing delayed the development of rebuilding plans in the California sardine fisheries and in eastern Canadian groundfisheries (McEvoy 1986; Charles 1997).

In the case of the California sardine fishery, post recovery activities included the development of a public-private partnership between the fishing industry and academia that resulted in the formation of the California Cooperative and Oceanic Fisheries Investigations to investigate factors that caused the stock collapse. Scientific findings indicated that while overfishing was the primary factor, environmental change (particularly El Nino*)* exacerbated the conditions for collapse. These scientific debates created the necessary spaces for hypothesis development and the institutional partnership and legal codes and Acts essential to rebuilding these fisheries. The sardine fishery moratorium was lifted in 1986 and by the year 2000, the stocks had recovered fully. This example illustrates the central role of multidimensional power relations in contributing to the sardine fisheries collapse and in constraining or potentially opening up new spaces and possibilities for rebuilding.

Although power, equity, and justice are highly intertwined (Gaventa, 1980), these interlinkages are rarely considered in the assessment of rebuilding initiatives for commercial fisheries (Sinclair & Ommer 2006; Khan & Neis 2010). Equity is defined from a sustainability perspective within the context of just and distributional procedures (Solow 1991; Gray 1998; Sutinen 2007). Whilst distributional equity considerations mostly stemmed from Rawls's *difference principle* (Sumaila & Bawumia 2000), procedural equity primarily lies with Nozick's *entitlement theory* (Graafland 2007). Equity can also be defined in terms of *intergenerational* concerns mainly for the restoration of long-lived species and benefits to future generations (Sumaila 2004; Sumaila & Walters 2005).

The remainder of this chapter uses a power analysis of the Northern Gulf cod fish chain showing how the pre-collapse fields of opportunity and related power relations fuelled the expansion of unsustainable and poorly documented overfishing dominated by one sector, and muted public discussion of this overfishing. The post-collapse analysis shows how, despite post-collapse shifts in the balance of power, the continued dominance of some groups and a related panacea approach to fisheries management have constrained rebuilding options, contributing to the stalled rebuilding of Northern Gulf cod fisheries. These discussions help to make visible the role of power in fish chain dynamics amongst stakeholders. The last section of the chapter uses our case study findings to inform a discussion of alternative rebuilding options we refer to as 'clumsy solutions' that we hope will raise awareness and change the space for action around rebuilding in the Northern Gulf. This entails supporting the integration of multiple and diverse stakeholder interests and viewpoints in an effort to resolve wicked rebuilding problems as discussed in Khan and Neis (2010). This approach requires taking into account governing principles such as efficiency, equity, legitimacy, respect, and the need to create new spaces and stronger institutions for change (Kooiman *et al.*, 2005).

Methodological approaches

As with earlier chapters, this chapter draws on data gathered along the fish chain using two main methods: i) a literature review and document analysis related to Northern Gulf cod fisheries; and, ii) multi-stakeholder key informant interviews. The document analysis relied on existing and historical documents, policy and legal statutes, scientific reports, statistical information, market and trade reports, and government commissioned reports spanning four decades from the 1970s to the present. These documents were used to track fish landings by taxa and species, price and landed value, fleet size and fishing operations, changes in fisheries policies, restructuring and social adjustment programs, conflicts, price-setting mechanisms, consumer preference, consumer markets, and trade flows. Semi-structured face-to-face and phone interviews were conducted with fifty key informants in addition to ten informal discussions with representatives of diverse stakeholder groups along the Northern Gulf cod fish chain. The list of key informants was developed based on background research during the document analysis research, as well as through snow-ball sampling techniques. The key informants included:

A. Seven scientists and fisheries managers with experience on resource conservation policies and ecosystem health;
B. Twelve resource users with historical and cultural experience in fish harvesting;
C. Eight entrepreneurs in the processing and retail sectors as well as plant works;
D. Seven municipal and community planners;
E. Ten bureaucrats and other decision-makers at organizational levels with emphasis on federal, provincial, trade unions, and inter-governmental organizations; and
F. Six research analysts from consulting and academia, in addition to other civil society representatives such as the media.

Some interviews were conducted throughout northwestern and southwestern Newfoundland in the 4R3Pn gulf region in the fall of 2009. Additional interviews with regional fisheries managers and policy makers in St. John's (NL), Mont Joli (Quebec), and Ottawa (Ontario) were undertaken in the winter and spring of 2010. The interview sessions lasted an average of two hours. They focused on understanding the policy process and decision-making approaches to governing challenges and rebuilding opportunities. Information in the interview transcripts was arranged and coded by themes to identify issues around which there was a general consensus, as well as those where there were disagreements and some heterogeneity in the responses, especially in relation to assessments of rebuilding challenges and opportunities. The analysis of documentary evidence and key informant transcripts for this chapter focused on several interview themes relevant to power dynamics including space, level or place (geographical scale), social organization and management and forms of power as shown in the power cube. Central to the analysis are factors such as indications (or the lack thereof) of agenda setting linked to the design of governance institutions and the inclusion/exclusion of groups and perspectives; the presence and/or absence of diverse perspectives and concerns across stakeholder groups is also considered. These different perspectives might support opportunities and an argument for clumsy solutions, in addition to suggestions for organizational and policy change that might introduce new participatory spaces that could help improve the balance of power and increase the likelihood of rebuilding that is socially just and equitable.

Results

Power and fishery collapse in the Northern Gulf

In this section, we first provide a short brief overview of key features of the fishery in the pre-collapse period. We then argue that the geographical distribution of the Northern Gulf cod stocks and their migratory behavior in relation to adjacent communities produced a unique management challenge that was exacerbated by the spatial scale of management in place after 1977, and related development of a mobile 65' dragger fishery for cod.

The coastal communities in the Gulf of St. Lawrence, in particular on the Great Northern Peninsula and in the Port aux Basques area, were heavily dependent on the groundfisheries resources in the past (Felt and Sinclair, 1995; Hamilton and Butler, 2001; Hamilton *et al.,* 2004).

Cod was the most important of the groundfisheries, in addition to redfish, turbot, plaice and halibut. In addition to groundfisheries, salmon, herring, shrimp, scallops and lobsters were fished commercially, and incomes were often supplemented with other resource activities such as lumbering and small-scale farming (Sinclair, 1985). In the pre-collapse period in the 1980s, fisheries contributed about 75% or more of total employment throughout this region especially in larger communities such as St. Anthony, Port Saunders, Port aux Choix, Rocky Harbor, Norris Point and Cow Head; in addition to regions in the Port aux Basques-Channel region, the Port Au Port Peninsula, and Codroy Valley (Figure 2).

This constellation of factors plus the introduction of an enterprise allocation system in the early 1980s, a form of quota system allocated to individual boats, now referred to as ITQs, changed the field of opportunities to benefit one particular group (i.e. the dragger offshore fleets) within the Northern Gulf. This change was made possible by augmenting the resources and power of the dragger fleets relative to fixed gear harvesters and undermining state capacity to protect the interests of inshore harvesters as well as to protect the Northern Gulf cod stocks from overfishing. Opposition to this shift in the balance of power and open concerns about its impacts were greatest in the Port aux Basques region among affected hook and line fish harvesters and processing workers. It was more muted in the Port aux Choix region and further north where the dragger fleet originated because of the relative importance of these fleets to the local economy and familial employment links (Palmer and Sinclair 1997).

The development of an industrial union in the NL fisheries in the 1970s and 1980s shifted the balance of power between processors and harvesters as they participated in policy decision-making. Most of the contention was to improve the collective bargaining power of the union through negotiations with processors and merchants regarding fish price and revenue distribution along the marketing chain as discussed in Chapter IV. This, however, did not prevent the overharvesting of the northern Gulf cod stocks. This is partly because the union represented all of the different fleet sectors and the Port au Choix dragger skippers were particularly powerful within the union at least in its early years (Inglis 1985).

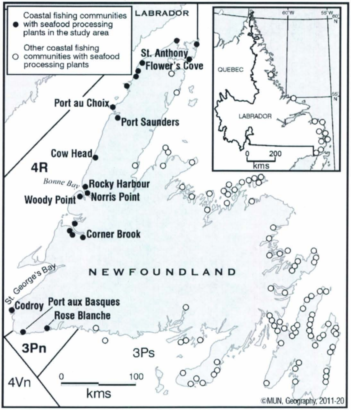

Figure 2: Northern Gulf Cod fishing regions and communities in Newfoundland and Labrador in 2009 (Adapted from McManus, 1991 and Department of Fisheries and Aquaculture Annual Seafood Report 2010)

Decision-making structures in the pre-collapse era contributed to power differentials and regulatory failure by providing more resources to the offshore dragger fleets through capacity enhancing subsidies as well as allocation mechanisms for boat quotas under the enterprise allocation system (Sinclair 1986).

In the Northern Gulf, as with other parts of Eastern Canada post 1977, fisheries science and management were the responsibility of the federal Department of Fisheries and Oceans (DFO). Cod were managed at large spatial scales bounded by the Northwest Atlantic Fishery Organization (NAFO) regions that did not correspond fully to stock structure and migration patterns or to underlying fleet complexities (Bavington 2010). Decision-making was very top-down and scientific advice on stock abundance and projected biomass were obtained from the Canadian Atlantic Fisheries Scientific Advisory Committee. Management measures were largely guided by the establishment of total allowable catches (TACs), allocation of the TACs and, over the course of the 1980s, control measures related to access and fishing effort. In the Northern Gulf of St. Lawrence, although all cod in 4R3Pn were managed as one unit, there was limited knowledge of stock migration patterns at that time. It is now known that some portion of the stocks actually migrate outside of 4R3Pn in the spring (DFO 2010a), with concerns about institutional fit to ecosystem boundaries. These stocks migrate south eastward into 3Ps (this may or may not be a recent development) and there is another stock that remains in the 3Pn area year-round (see Figure 2 in Chapter III). The main body of the stock has historically migrated north from the Port aux Basques area to feed in the summer, with some of it entering the 4S region and sometimes crossing the boundary into 3L north of the Strait of Belle Isle. Some parts of the stock travel into White Bay on the east side of the Northern Peninsula before returning to the 3Pn region to overwinter (Murray *et al.,* 2006). Furthermore, some cod do not migrate but remain in 3Pn and other areas along the coast (Methot *et al.,* 2005; Yvelin *et al.,* 2005). These mis-matches in scale between ecological and management boundaries also raise questions about risks and habitat protection requirements for eggs, larvae and juveniles, but also for adults and spawners.

This migration pattern meant that fixed gear fishers who did not follow the migrating stocks to any significant degree could only access these cod during limited periods. It also resulted in different patterns of seasonality along the coast with harvesters in 3Pn and the southern part of 4R engaging primarily in a fall and winter fishery and those further up the coast intercepting the cod often for relatively short periods of time as they passed through the region in the summer. These 'closed' spaces of power related to the misfit between the management zones and the underlying stock structure in addition to the lack of resources for some groups to fully participate in decision-making led to stock collapse.

The TACs were set (starting in 1977) based on the results of largely offshore trawl surveys, information on landings (fishing mortality) and stock status based on statistical estimates and modeling (DFO 2010a). Here, as with Northern cod (Finlayson 1994), there were overly optimistic stock assessments linked to problems with the reliance on commercial trawler catch per unit of effort as an index of abundance, the tendency of non juvenile cod to aggregate as abundance declines (Bennett, 2008), and under-estimates of fishing mortality exacerbated by un-reported discarding, high grading and under the table sales (Palmer and Sinclair, 1997). These led to expanding TACs that were, in turn, surpassed by reported landings by 5 to 20% each year between 1978 and 1984 (DFO 2010a). With increasing recognition of the impending collapse, TACs were reduced substantially starting in 1990 and were cut to about 18,000 tonnes in 1993 compared to a peak of 100,000 tonnes in 1984 as shown in Figure 3. Two short moratoria on directed fishing for cod were implemented between 1994 and 1996 and in 2003, and by-catch restrictions on cod (DFO 2010a). In the intervening years after the collapse, the TACs varied between 3,000 and 7,500 tonnes. DFO (2010a) assessment now indicates these TACs were too high to support rebuilding and it has reduced the TACs again in recent years (4,000 tonnes in 2010 and 2,000 tonnes in 2011).

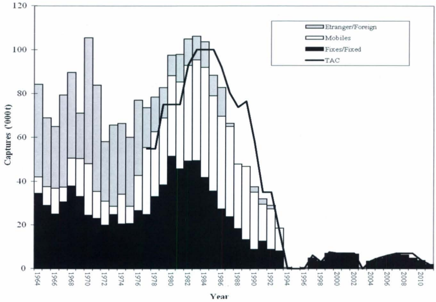

Figure 3: Trend in landings, quota allocations, and TAC in Gulf of St. Lawrence (source: DFO)

Prior to 1976 and extended jurisdiction, the foreign fleets obtained about 50% of the reported catch. After 1976, the foreign quota was reduced to about 10 to 20%. According to one informant, between 1977 and the present (2011), about 3% of the Northern Gulf cod quota allocation has been reserved for the large French trawlers out of St. Pierre and Miquelon but foreign and mobile allocations have been reduced to nil until the quota exceeds 9,000 tonnes after which they are scheduled for gradual reintroduction.

The original share of the offshore TAC that was allocated to the <65' dragger vessels, most of which originated in Port Aux Choix, Port Saunders and Anchor Point on the Northern Peninsula, was approximately 40% in the pre-collapse periods. This fleet expanded from less than ten to a peak of 75 vessels in the 1980s (Palmer and Sinclair, 1997). There was also an inshore fixed gear allocation harvested by small boat fish harvesters using hook and line in the Rose Blanche to St. George's region; and using cod traps, gillnets and hook and line further north. They were originally allocated about 40% of the TAC. However, during this pre-collapse period, any quota not caught by the fixed gear fleet by the end of their season was transferred to the <65' dragger fleet. As a result, whereas "in the 1960s to the mid 1970s, the fixed gear sector accounted for approximately 80% of the total cod landings in the 4R3Pn fishery … [in the late 1980s' and early 1990s] less than 30% of the total cod landings in the 4R3Pn [came] from the fixed gear sector" (as cited in Palmer 1992; see also DFO 2010a). If we incorporate unreported landings and discards for all sectors, the percentage was probably even lower. In the early 1980s, the <65' mobile gear allocation was converted to Enterprise Allocations (a form of vessel quota) and then to individual transferable quotas (ITQs) in 1987 (Palmer, 1992).

Although the role of the French trawlers in the collapse of the Northern Gulf cod stocks has not been fully documented, there is ample evidence to suggest that the <65' draggers took advantage of the field of opportunity created by their mobility and fishing power, the spatial mis-match of management to fishing activities and stock structure, the enterprise allocation system, and the absence of any effective monitoring, to advance their own interests. "…Whereas the offshore [65' boats] can go out to the fish… I'm in a little 20' boat, and I'm fishing from Woody Point, say here, and the fish don't come in. What do you get? Nothing." The mobile draggers intercepted migrating fish that would, in the past, have been caught by inshore harvesters. The increased power of this mobile fleet was reflected in a fishery boom called the 'glory days' for those involved with the dragger fishery in communities like Port au Choix (Sinclair 1985; Palmer and Sinclair, 1997).

Furthermore, as predicted by Copes (1986), the introduction of Enterprise Allocations and, as with other fisheries, the declining size of fish due to overfishing, combined with the absence of any onboard or dockside observers in the fishery, produced high rates of discarding that escalated as they sought to sustain trawler catches as abundance declined, 'net lining' and 'under the table sales' (Palmer and Sinclair 1997; Hamilton *et al.,* 2004). These unsustainable practices led scientists to underestimate fishing mortality and overestimate stock abundance, as commercial catch per unit of effort was used, inappropriately, as an index of abundance and landings data were used to estimate fishing mortality. The result was data fouling and an over-estimation of stock abundance with inflated TACs contributing to overfishing (see Finlayson 1994; Wernerheim and Haedrich, 2007). This informant describes what this fishery looked like and its dynamics, including the 'under the table sales' that became the norm in the industry in the 1980s.

> Respondent: Well like you know, back when there was lots of fish; thousands of fish before the moratorium. … They [draggers] come here to Port Aux Basques, … there's, one, two, three, four, they even got pumps … up to the Marine Atlantic port, pumping cod. Supplying all Newfoundland, biggest part of Nova Scotia, and we couldn't get any cod … because … if you come in with 100,000 they used to mark down 50 and pay you cash for the other 50.
>
> Interviewer: What did people think, with all the draggers coming? Were people here a part of those who owned the draggers or was it mostly other people from other places?
>
> Respondent: No, it was only about a half a dozen draggers located here. The biggest part of them used to come down from Port Au Choix, Anchor Point, and Englee, all them places. My opinion, that's what got this industry in the mess that it's in to today. Maybe

> that's if you want to look at the real problems that we got. Maybe that's why the fish is not stopping here to migrate. Let's face it … if this is your backyard here, and if I comes in to here with a tractor, …takes one of them nets that we're using out there to tow back and forth that bottom, goes over grass once a day, at the end of the week, it's not looking very good, is it? You got a hundred draggers out there going back and forth, back and forth, in the main body of fish, where all the fish was, going over the bottom, over the bottom, over the bottom every day with this big net and those big doors go back and forth. Jesus had to [do] something.

There were growing concerns among small boat fishers and others as their catches and incomes declined and as they witnessed unsustainable fishing practices (Palmer 1992) but often seem to have felt very 'powerless' to do anything about it. During the 'glory days' of high landings and intense resource exploitation, Palmer and Sinclair (1997) documented quiescence in many places on the Northern Peninsula. As argued by Gaventa (1980), peaceful social relations are not necessarily an indication of equity and exemplify the complexity of power relations. Some informants suggested that one reason why so little was said and done about the problems with net lining, discarding and under the table sales in particular was because many fish harvesters and buyers were involved. If a skipper chose not to line his nets, his crew would pressure him to start doing this. If a buyer was not willing to engage in under the table sales, a skipper would stop selling to him until he caught on and joined in.

Protests from small-scale fish harvesters and others seriously affected by the overfishing prior to the collapse took place along the coast but appear to have been stronger in the Port aux Basques region than further north, near Port au Choix. The protests and conflict centered around three main issues: discrepancies in earnings and access to fish; illegal fishing activities; and concerns about overfishing and stock decline (Palmer 1992). As noted by a former civil servant, "[t]here [was] tension between inshore and offshore in the 1980s, incredible friction between these two groups. What it reflected was really this new phenomenon of haves and have not's." And, as noted by Palmer, "although the silence enables social life to continue, it greatly diminishes the possibility of fishers having meaningful input into the resolution of the conflict" (Palmer 1992: 27). One result of the Port aux Basques region protests was the eventual establishment of a buffer zone in the late 1980s called the '100 fathom edge' mainly for exclusive access by inshore fishers and habitat protection for inshore cod in the region (Palmer and Sinclair, 1997). However, by the time this was implemented, cod had largely ceased to migrate inshore perhaps due to low stock abundance and related 'spatial contraction' due to density dependent factors (Bennett 2008).

One of the potential spaces for increased equity and positive social change, including better access to decision-making for all fish harvesters, was associated with the unionization of harvesters and some processing workers starting in Port au Choix in the early 1970s and spreading to other parts of the province by the 1980s (Inglis 1985). Such participation in new social relationships including gaining access to decision-making arenas can raise the awareness or consciousness of a group's interests (Gaventa 1980). Historically, disputes in the fishing industry primarily focused on merchant control over the fishery (Wright 2001), related equity issues of fish price, gear conflicts and, after 1955, the effects of foreign fleets and the need for greater Canadian and NL control (Government of Newfoundland, 1978; Macdonald 1980). Poor social relations between harvesters and merchants/processors have been identified as one main reason for the establishment of the Newfoundland Fishermen, Food and Allied Workers Union (NFFAWU) founded in 1969 with strong leadership from Port au Choix fish harvesters (Inglis

1985). By 1987, it was a province-wide entity with links to other trade unions across Canada and internationally.

The NFFAWU and its successor, the Fish, Food and Allied Workers (FFAW) union, have played a key role in policy developments leading up to the collapse of the Northern Gulf stocks and in events and decision-making since the collapse. The current FFAW union membership includes both skippers and crewmembers, and encompasses the inshore, mid-shore and offshore vessel types as well as plant workers. Institutional mechanisms for collective bargaining, better labour relations, and social welfare are among the major benefits it has brought to union members (Vardy *et al.*, 1998; Jones 2003). The FFAW's motto is "Fighting Back Makes a Difference" and it has often 'created new spaces' for negotiation and power brokerage with both the federal and provincial governments as well as with processors and their associations. However, the focus of the union in the pre-collapse period was on redistribution of wealth between merchants, workers, and fish harvesters, and improved state programs, not on the problem of overfishing.

Also important in terms of power structures was the former Fisheries Association of Newfoundland and Labrador (FANL), a trade organization of fish processors and buyers. This association represented large and small fish companies including companies with their own rapidly expanding offshore trawler fleets and, by the early 1980s, Enterprise Allocations. Some smaller processing companies along with fixed gear fish harvesters challenged cod stock assessment and supported changes to fisheries management (Finlayson 1994). However, they were less powerful within the pre-collapse institutional structures and had much less room to maneuver than the larger fleets and seafood processing companies (Dean 2001; Bavington 2010). While the large Canadian companies with their own fleets were less engaged in the Northern

Gulf fisheries, they owned some plants in the area and local smaller processors that depended on the fixed gear fishery.

In summary, the power dynamics along the fish chain in the northern Gulf fisheries between 1977 and 1994 contributed to management failure and ultimately to stock collapse. It also created closed spaces for policy making and a related field of opportunity that encouraged and benefitted the mobile sector more than the fixed gear sector in the short term (although everyone lost in the end). The TAC system and the effectiveness of centralized management depended on robust science that, in turn, depended on accurate reporting of fishing mortality and informed understanding of the behavior of fish and fishers and how these might influence catchability and reported landings. None of the institutional mechanisms existed to remedy the unsustainable fishing practices and to promote stewardship amongst the mobile fleets. In their absence, fishing mortality grew rapidly in a largely uncontrolled fashion but not all sectors were equally responsible for the decline. TAC allocations, delay or non-action on the part of government also benefited some groups at the expense of others and society as a whole in both the short and longer term. Of course, all of this is clearer in hindsight with better science and clear evidence of collapse (Walters and Maguire, 1996). At the time, with Northern Gulf cod as with other eastern Canadian cod stocks, there were indications that the fish had migrated rather than collapsed, limiting immediate policy action but also providing opportunity for research (Smedbold *et al.,* 2002).

With science and management resources centralized in DFO offices in Ottawa, and Mont Joli, far away from what was happening on the ground in Newfoundland; a union membership that included multiple sectors with conflicting interests; a processing sector focused on marketing and dominated by big integrated companies with trawler fleets of their own; familial and other social ties between fishing sectors; weak to nonexistent enforcement and increasing collusion across groups in quota busting, the space for claims about overfishing and resources for moving that agenda forward were highly constrained and contributed instead to quiescence. Where protests were overt and sustained, as on the southwest coast, these were addressed through incremental management changes that were too little, and too late. While concerns about stewardship and equity were sometimes openly articulated, the spatial, social and scientific dynamics of the fishery tended to 'close off spaces' for promoting stewardship initiatives and responsible fisheries that could have prevented collapse in the first place. These closed spaces for policy reforms and the lack of government intervention to rectify allocation concerns and prevent abuses such as data fouling and discarding contributed to the fisheries collapse.

Power, stalled rebuilding and emerging governance thinking

The rebuilding of the Northern Gulf cod stocks has stalled despite two moratoria, more than a 90% quota reduction in TACs, and huge investments of public funds, particularly in the form of capacity reduction and adjustment programs as discussed in Chapter III. The current stock status is below conservation reference points as the standing stock biomass is about 10% of its historical levels (DFO 2010a).

As discussed in Chapter III, stalled rebuilding has occurred despite extensive consultations with stakeholders and stewardship mechanism, some institutional reforms including the introduction of dockside monitoring, a sentinel fishery to provide inshore data for stock assessments; and a substantial shift in effort towards high value shellfisheries and, until recently, towards the seal hunt. Post-collapse management measures such as those to reduce capacity contributed to hardship and loss of livelihoods for some, while others sometimes became wealthy. Some have criticized the adjustment and social welfare programs for creating dependency and discouraging entrepreneurship because of the lack of local development initiatives. Others have emphasized the role of centralized management and narrow sectoral and disciplinary-based approaches to complex social-ecological problems in creating ongoing poverty and stalled rebuilding of these fisheries (Shrank, 2005; Ommer *et al.*, 2007). They suggest that adjustment programs have been reactive and have undermined, to some degree, the human and institutional capacity of fishing communities particularly those with an aging population and with intergenerational concerns about who benefits when the stocks are rebuilt.

Most key informants in the fishing industry and coastal communities expected DFO to use its constitutional power to act and resolve some of the on-going fisheries challenges in NL and eastern Canada. One key informant underscored this by perspective by saying: "…I mean scientists can say what they like. Fishermen can say what they like…fish managers say what they like. All of it rests with the Minister of Fisheries." A senior DFO scientist further explained the Minister's role in policy decision-making:

> 'In terms of doing the cod assessment we do the advisory document and which says essentially, what the status of the stock is, and what the risks of different catch levels are. And ultimately it is the minister who makes the decision on the quota.'

The viability of the NL west coast fishing industry and of some fishery-dependent communities is quite marginal (Sinclair and Neis, 2008), including many communities where plants have been closed (as shown in Figure 6, Chapter IV). Many of the alternative fisheries are experiencing serious challenges related to rising costs and low prices (DFO 2007; Khan 2010). These challenges have been exacerbated by recent reductions in crab and shrimp quotas and, in regions like St. John Bay, by overfishing of lobster (Whelan 2005). As a result, many fishery-dependent households and some processors in the region are struggling to survive, including particularly those most historically dependent on the cod fisheries (such as on the Great Northern Peninsula and parts of the Southwest coast). In these areas, inshore fish harvesters often have limited access to other species and other resource-based industries such as forestry are in decline (GNPFT 2006; Sinclair and Ommer, 2006). As a result, permanent and temporary employment-related mobility away from the region are quite common among both young people and people with families (Jackson *et al.,* 2006).

What, if any, is the current relationship between power and stalled rebuilding in the Northern Gulf fishery? Clearly, the field of opportunities has changed since collapse. There have been important improvements to stock assessment science and fisheries management with the collaborative sentinel fishery and better landing data (CPUE) for statistical analysis in determining future harvest rates. Scientists no longer rely solely on commercial catch per unit effort (CPUE) as an index of abundance. Besides, data on fishing mortality and fleet monitoring are better than in the pre-collapse era, due to the introduction of logbooks, at sea observers, dockside and vessel monitoring systems (DFO 2010a). However, the capacity of scientists to protect fish stocks has been constrained by a relatively strong requirement for accurate science that has been difficult to achieve. This is partly due to limitations in the Species at Risks Act (SARA) for not stipulating rebuilding targets, and relying on a narrow cost benefit analysis that is beyond the mandate of COSEWIC as discussed in Chapter III.

Another constraint on stock protection and a basis for fatalism is an ongoing sense of injustice and who should pay for the cost of overfishing, particularly amongst small boat harvesters in the Port aux Basques area, regarding a perceived change in cod spawning migration and the possibility of winter fishing in the 3Pn region. There are ongoing issues related to mismatch of management jurisdiction, stock migration patterns, and its relationship to the ability of different fleets to access the resource as the TAC increases to accommodate the entry of mobile fleets. According to one key informant in the processing sector: "history may repeat itself again" if the mobile fleets were to take part in the fishery.

One important conservation initiative led by fishers and implemented by DFO was the identification and closure of a groundfisheries spawning area in the Bay St. George region in southwestern Newfoundland in the early 1990s. Related to this, the fish harvesters interviewed were generally proud of their conservation initiatives and stewardship ethic, and presented examples of other locally led management initiatives such as in Petty Harbor, Gilbert Bay, and the Eastport Peninsula. A senior FFAW officer identified important milestones in knowledge mobilization for policy decision-making since the cod stocks collapsed, and a positive shift in social relations:

> 'There were a lot of disputes between harvesters and science [on crab surveys and other stock assessments methods]...Over a two year period we sat down with scientists, we used fishermen and the scientists and we developed a crab pot survey. Solid scientific protocols behind it yet with the knowledge from harvesters…This year will be the eighth year of the survey. I think the development of that survey, the fact that the harvesters involved with carrying out the survey, they're involved in assessing the results of the survey…for management decisions to be made…That's the most solid collaboration that we've got here...'

In the post-collapse era, DFO has established two sentinel fisheries that provide supplementary data for trawl survey stock assessments related particularly to nearshore and inshore distributions and abundance of cod. The sentinel fishery was implemented by DFO to include fishers' knowledge and perception on the status and abundance of fish stocks and to deal with any resulting discrepancies. One of these fisheries is carried out by nine mobile sentinel vessels and by several fixed gear harvesters using gillnets and long lines that are spread along the coast (DFO 2010a). According to key informants in the harvesting sector, the sentinel fisheries provide extra income and fishing time for those involved, and participation in this fishery is not rotated because of concerns about possible consequences for data quality. However, the absence of a rotation system has led to concerns about fairness and equity among those who are not part of the system, and charges of nepotism and cronyism on the part of some. Several key informants recounted issues of poor fish prices and the lack of outside buyers. The on-going needs of inshore fish harvesters have fuelled some divisions as reflected in efforts to form a competing organization to the FFAW representing inshore fish harvesters only.

Some changes have been designed to address legitimacy concerns related to stock assessment and fisheries management that, during the pre-collapse period, took place behind closed doors. Thus, in the early 1990s, the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) was disbanded and replaced by the Fisheries Resource Conservation Council (FRCC) with appointed representatives from government, academia and industry. With this shift, decision-making became more open and somewhat more transparent (Finlayson and McCay, 1998), although the FRCC has been convened to work on groundfisheries only sporadically in recent years. The early work of the FRCC focused on scientific advice and conservation proposals for fish stocks; a more recent set of meetings focused on rebuilding and encouraged broader regional community engagement with policy recommendations for groundfisheries rebuilding.[24] Their last publication before being disbanded in October 2011 was entitled *Towards Recovered and Sustainable Groundfish Fisheries in Eastern Canada.* It documents the history of efforts to rebuild these fisheries (with a focus on stock recovery) and

[24] http://www.frcc.ca/Press7.htm last accessed July 30th 2011.

outlines approaches necessary to achieve recovery, including ecosystem-based and precautionary approaches, culling of seals, and the potential role of governance and seafood market considerations (FRCC 2011). The establishment of the FRCC was designed to deal with the 'hidden aspects of power' in the pre-collapse era such as documented problems with government information control, state intervention in science (Hutchings *et al.,* 1997), and concerns about closed door negotiations with industry (Finlayson and McCay, 1998). Despite their role and influence, the FRCC has been disbanded as part of a round of funding cuts by DFO, which are raising widespread concerns about the future of fisheries conservation and environmental issues across Canada[25].

There are, however, on-going concerns about spaces for influencing decision-making through lobbying and self interest that are not accessible to all in the industry. For instance, the 'special committee for the return of the mobile fleet' by the Groundfish Enterprise Allocation Council, established in 1997, represents offshore groundfish fleets. A key purpose of this organization, based in Ottawa, is to lobby decision-makers in Ottawa to protect historical allocations of groundfish to the larger fleets especially greater than 100'. This is illustrated by the organization's 2001 response to a DFO Policy Document on management of fisheries on the Atlantic Coast. In their response, it was argued: "Unless the new Policy Document confirms long-term percentage allocation shares to be used in 'established fisheries' like groundfish, prescribing continuation of the most recent allocation shares in all groundfish stocks in clear and unequivocal terms, then the Policy Review will be a failure!" Concern among fixed gear harvesters in the Northern Gulf about the committee is related to the plan to allow the draggers back into the fishery once the quota reaches 9,000 tonnes.

[25] http://greenparty.ca/media-release/2011-10-18/fisheries-resource-conservation-council-disbanded last accessed December 15th 2011.

Although fisheries science and decision-making have become somewhat more inclusive and transparent in the post-collapse era, there are diverse interests along the fish chain and limited opportunities for formal stakeholder input into decision-making at local and regional levels. Evidence of these diverse interests and lack of participation is ongoing protests and, for some, a sense of fatalism. An example is an incident in the summer of 2009 when harvesters protested and shut down the DFO office in Corner Brook because of the federal government's inaction on the poor price of fish: "Usually if you got the guts to go out and shut down a building, get the meeting in, voice your concerns, usually it ends up in your favor." The protest provided an opportunity to open 'closed spaces' for the reformulation of issues and strategies. As underscored by a union representative, such opportunities require common grounds and inclusive decision-making:

> Most times it's in terms of finding that common grounds. One of the biggest transitions we went through in this province was when groundfish went and shellfish came. We shared with many. We did it. Through a lot of internal debate, we managed to lead our communities through it. So how do you take the same thing? You got a diverse group of interests. How do we create some kind of structure so that we work it out in a group? They are forced to find a common ground as a community. Something got to push it in that.

However, some fixed gear harvesters remain convinced that the government is conspiring to eliminate them from the fishery: "the government doesn't want the small boat fishermen; they are a cost, not an asset … [b]ecause we fish for six months of the year. The other six months we're drawing unemployment [insurance]…They want a 100' dragger; when he comes ashore they fire it up on a truck and sends it to the marketplace… it is the bureaucrats that got the fishery in the state that it is today." A harvester in southwest Newfoundland saw the policy process as skewed against the fish as well. He talked about how he saw difficulties reconciling different agendas as linked to the stalled rebuilding of the stocks:

> 'There's politics at play [t]here; scientists have their agendas and the politicians have their agendas and the fishermen's union has their agenda and the fishermen have their agenda... [They] can't get together because their agendas are not being met [and deliberated]. Fishermen want a larger quota, scientists…they don't want to move out of their office but they want all the information. They don't want to go and collect it…And then the politician, his agenda is to get voted, to get elected. And then you got the managers... they need to get their years in and get their pension. The interaction between these four agendas...usually what loses is the fish. The fish usually loses…'

Prolonged or stalled rebuilding (which in and of itself can fuel distrust of science and management and internal divisions) and related livelihood challenges are affecting power relations in the post-collapse era in another, more indirect way. Only those enterprises that are able to survive until the cod stocks recover will benefit from the effort invested in helping them to rebuild. This relates to the larger question of 'rebuilding for whom' or, to use Gaventa's power cube (Gaventa 2006), the question of who will occupy fisheries space in the future. Although temporarily excluded from the cod fishery, the <65' mobile vessels in NL with shrimp licenses have been given access to larger shrimp quotas including some in area 2J and 3K whereas fixed gear west coast NL fish harvesters have been excluded from access to Northern Gulf shrimp and those in the northern part of the Gulf do not have access to snow crab.

There are ongoing concerns about inequity, particularly from small boat harvesters who are struggling to survive and the loss of a cultural heritage if future spaces are not negotiated for youth involvement. Furthermore, much of the remaining Northern Gulf cod quota is managed as a competitive quota; unlike regional quotas in the 4S region in Quebec and the use of individual quotas in 2J3KL region in eastern Canada. The competitive fishery consists of limited fishing periods per week with different quotas for the different fleets. Given the timing and direction of summer cod migrations in 4R3Pn (from south to north), harvesters in 3Pn and the southern part of 4R have the potential capacity to catch much of this quota before it arrives in more northern regions. This has been a source of conflict among fixed gear fish harvesters in the region. In the short term, this can give the southern fixed gear fish harvesters' better incomes than further north with ramifications on the value of licenses and livelihood options.

As fixed gear landings declined prior to the collapse and with declining opportunities for fish processing work along the coast, fish harvesting households attempted to improve their livelihoods by incorporating the wives of harvesters into enterprises (Grzetic 2004). This had the advantage of concentrating dwindling harvesting income and related Employment Insurance in fewer households. It laid the basis for a somewhat different kind of enterprise with somewhat more balanced gender relations. As remarked by one female harvester, some enterprises are now owned by husband and wife, with full partnership and are family run businesses. "It's different now because a woman can go out in a boat with her husband and they have hauler motors, and everything is just brought up and brought in. It's easier, it's so much easier now [compared to the labour intense cod trap era]." However, this strategy displaced crewmembers from other households and limited the space for the entry of owners' sons and daughters into the fishery thus sacrificing future recruitment. Plant closures and downsizing had a similar effect as younger women and men with less seniority lost their positions. As a result, the current fishery labour force is aging, as are fishery dependent communities. The virtual absence of young people from the fishery also raises questions about who will occupy future space in the fishery and benefit from rebuilt stocks- should the stocks recover.

Fishery-dependent communities and regional development agencies have had no direct role in fisheries in the post-collapse period despite heavy dependence on the industry in most areas and thus vulnerability to industry and policy changes. The establishment of twenty regional economic development boards (REDBs) post-collapse was primarily designed to address livelihood concerns, labour market needs, and to coordinate community development enterprises across various federal and provincial agencies and departments (Belbin 2007). However, communities and REDBs were given no fisheries-related mandate in the post-collapse era and have been somewhat information-starved. Key informants highlighted challenges with their exclusion from fisheries-related decision-making and related limitations in their own technical resources and institutional capacity to make sense of and influence fisheries developments.

The main policy focus since the collapse (other than stock recovery) has been on downsizing – i.e. reducing the numbers of harvesters, processing plants and buyers in the industry (Ruseski 2007). Downsizing has the potential to improve industry resilience but it is not sufficient to achieve the rebuilding goal and this kind of policy approach neglects other issues such as constraints on marketing options for harvesters that might allow them to maximize the wealth they can generate from small quotas, as well as intergenerational equity, and community and other impacts that relate to the ongoing power issues discussed above. One reason for this is the risk that downsizing will lead to corporate concentration (Dean 2001), reduced bargaining power among the surviving harvesters and plant workers and thus lower prices and wages. As explained by a former public servant:

> 'I think corporate concentration will become a big issue because what you're going to see out there now, more consolidation, and a strong tendency for certain key companies to grow. The Barry Group, Quinlans, the Daley Group, Chess Penney are big players… those companies with strong access to capital will take advantage of this situation to extend their power; probably more monopsony. That will make it more difficult actually for independent price setting and makes it more difficult for an auction [an alternative option to the current collective bargaining model].'

The on-going equity and governance challenges associated with policies that focus exclusively on downsizing were evident in the provincial government's response to a recent provincial report based on a Memorandum of Understanding (MOU) between key players in the fishing industry (the FFAW and Association of Seafood Processors – large processors) and the Provincial Government of NL. The MOU, signed in 2009, was designed to address stakeholders' concerns about resource supply and fishing capacity, changing global seafood markets, low returns, and implications for future restructuring programs. Several proposed action plans, working groups, and steering committees eventually resulted to the final report by Clift and Team (2011). The key policy recommendations in this MOU included: i) a reduction of about 30-80% of the inshore fishing fleet primarily on the northeast and west coasts of Newfoundland and in southern Labrador; ii) a reduction of up to 50% in the nearshore fleet sectors mostly affecting northeast coast of Newfoundland and southern Labrador; and, iii) a 30% reduction by volume in the current crab and shrimp processing sectors to try to achieve profit margins that are at par with other provincial seafood producing sectors in Canada. To achieve these downsizing goals, the authors of the MOU indicated the government would need to inject 450 million CAD into the industry.

The MOU recommendations, if implemented, would have huge implications for plant workers, some harvesters, and for fishery-dependent communities on the west coast's Great Northern Peninsula, the most fishing dependent region in the province. Although provincial government funding paid for the development of the MOU, the government rejected the recommendations. In his response, the Minister said that the MOU "…does not bring into play how the industry is going to be shaped differently so, basically, what is being requested is that we will downsize and hope things will get better. You are going to make the problem smaller, but the issues are still going to be there" (*The Coaster Newspaper* July 12, 2011 as cited on the CURRA discussion forum[26]). In the words of a key informant:

> The MOU is a politically charged, interesting, process. Reduction in the number of communities, quotas transferred, people are going to be really mad…The whole idea was to set rules so that the community could have input. [Instead] the only people to make decisions are government and industry; when they screw up they inject political money and consideration. You want to get an option that is the best case for the society. The way things have been organized in NL for the last few years, they've been trying to keep the communities out…

This concern about the marginalization of the interests of fishery-dependent communities in fisheries decision-making was reflected in the comments of another key informant with responsibility for regional development:

> 'The fishery is the core industry of most, of all, of our rural communities, our coastal communities; it's still a very large percentage. That's not going to change. You will have communities that exist today, that yeah, will fade into the sunset, as we call it. But you will always have a certain number of communities around coastal communities.

[26] http://www.curra.ca/fishery_MOU.htm last accessed July 11th 2011.

They will always be dependent on the fishery…and we have got to come to terms with this.'

In many regions of Newfoundland and Labrador, including parts of the Northern Gulf, the Newfoundland fisheries are very fragile, as is the future of most fishery-dependent communities. One key informant blamed this situation on a tendency to focus narrowly on economic efficiency and, related to this, on downsizing in the post-collapse era. He said: "How do you manage without taking into account social issues, how do you decide this community is going to survive and this one isn't. You're ignoring the fact that it's a human activity, the concept of embeddedness. A fishery is embedded in a society. The economic part is only one part."

There has been some attention to other issues since the collapse. Concerns about equity have been largely addressed by giving those in the <65' fleet range to access new quotas of crab and shrimp associated with expanding populations and, for now, pretty well all of the cod quota goes to these harvesters. However, these fleets are last into the crab and shrimp fisheries and the current policy requires them to be first out in the event of quota cuts which are now happening in these fisheries. There has thus been no fundamental redistribution of rights within these fisheries, and fisheries are not a core part of regional development strategies on the Newfoundland west coast (or elsewhere) even though other regional industries, such as tourism, rely on the presence of a vibrant fishery.

In the pre-collapse era before 1977, responsibility for science and management was top-down in the sense that it was a federal responsibility, but the system was poorly regulated and weakly enforced. In the post-collapse period, top-down management in terms of regulation (quotas, licensing and licensing requirements) has increased, with some responsibility (for paying for dockside monitoring for instance) and opportunities for input delegated to lower levels such as to the union, industry, or groups of fish harvesters. Some key informants think there needs to be stronger government regulation, while others have argued for reduced government engagement and more industry self-regulation, which may run the risk of regulatory capture. The state is, however, not a neutral umpire, as it often supports one group over the other. In the Northern Gulf, this is evidenced by the support for dragger fleets through various subsidy programs and the higher quotas that led to unsustainable fishing practices and overfishing in the 1980s (Sinclair 1986; Palmer and Sinclair, 1997). Furthermore, even those who argue for reduced government intervention have also asked for financial support from government to achieve their goals as with the recent provincial government MOU Report that asked for 450 million CAD in state funds to pay for further downsizing of the harvesting and processing sectors (Clift and Team, 2011).

This analysis of the post-collapse period suggests that power dynamics (among other factors) have contributed to stalled rebuilding in part by constraining the space for effective consideration of alternative options and approaches that might have addressed multiple ongoing concerns. Lost spaces for legitimate action and collective decision-making in the post-collapse era have, in other words, constrained fields of opportunity for imagining, designing and implementing institutions and strategies required for the rebuilding of both fish stocks and fishing communities. Related to this is the potential for a more equitable and sustainable future for the region, with the cod and other fisheries playing a central role in that future. Enhancing the potential for alternative 'clumsy' solutions that tap into the wisdom of stakeholder viewpoints and bring together these groups for dialogue and negotiating new spaces for collaboration is an option for the future that might help address these issues. This is the focus of the final section of this chapter.

Constraints and opportunities for clumsy governing options

From the point of view of clumsy solutions researchers (Verweij and Thompson, 2006; Rayner 2006), there are four primary stakeholder perspectives in most social situations for resource management that may have impact on all three stages of the fish chain. Clumsy solutions have the potential to create new prospects or enhance existing "fields of opportunity" for the development of options and institutions and potentially, for shifting the balance of power along the fish chain. According to Rayner (2006), one of the key prerequisites for clumsy solutions is the 'law of a minimum of three', which speaks to the need for a diversity of agendas or interests and for deliberations that go beyond mere participation to generating imaginative solutions involving these various stakeholder groups (see Douglas and Wildavsky 1983). Two main requirements for clumsy solutions in multi-stakeholder contexts include: i) an appropriate institutional framework; and, ii) stakeholder partnerships. Trust is very important for workable clumsy solutions; not only personal trust but also trust that is supported by institutional design and facilitated by human agency through cordial social relations and good leadership. Oliver Williamson argues that the twin of trust is 'betrayal' and that trust can be facilitated through institutional mechanisms that govern social relations (Williamson 1996).

As reflected in our discussion of post-collapse developments, while one perspective- a focus on individualism and economic efficiency (to be achieved through downsizing and privatization) has dominated policy and public discussions in the post-collapse era, there has been some attention as well to redistribution (focused on facilitating access to 'new' resources) and to shifting from command and control management to more local or at least industry involvement. In the post-collapse period, new policies for monitoring and surveillance include log books, dockside monitoring, at-sea observer programs, by-catch limitations (10% by-catch limits while directing for cod), and the adoption of vessel monitoring systems (DFO 2010a). For some stakeholder groups such as fish harvesters and processors, authoritative state power is seen as one mechanism to support rebuilding but also as a problem. For instance, equity and allocation concerns are paramount in the context of resource constraints and decision-makers tend to go for quick fixes and reactive policy measures that ignore the larger equity and political economy issues (Ponte 2007). Most key informants supported the need for participatory governance and for nested institutions appropriate for different scales of governance to deal with resource management challenges, coordination and equity concerns. According to a retired civil servant and scholar:

> ' ….put as much responsibility as possible on a localized idea. If you don't do that, if you manage a fishery from a region, all the problems bubble up to that level. The higher up they go, the more difficult it is to solve it, *remoteness of the problem* [emphasis added]. [At] a political level, you don't get a solution, the manager of Fisheries and Oceans Canada doesn't have a good handle on what is happening in Rose Blanche [fishing community]…the more authority you have, the more accountability.'

The bottom-up approach as suggested by some key informants is crucial for local stewardship such as protecting critical habitats in bays and for coastal area planning. But, whilst some stakeholders were in favor of bottom-up and multi-level governance structures to sustain coastal dependent communities, some other key informants suggested regionalization and downsizing of communities. This quote captures one key informant's response: "Do we need rural Newfoundland? There will have to be a downsizing of communities…That means the Ships Coves', Flowers Coves', Trepassey, all these small communities will have nothing to support them. You will have one [community] in Port aux Choix, one in St. Anthony, and everyone in between will have to go."

The growing use of such policy instruments as ITQs raises numerous distributional, intergenerational equity and other concerns (Apostle *et al.* 2002), especially from the union (FFAW, 2008). Downsizing has the potential to improve incomes and simplify management but also has the potential to create intergenerational equity issues (the cost of future entry – i.e. license purchase- can be too high for the next generation), particularly if downsizing relies on individualistic strategies like license freezes. ITQs can enhance the general downsizing risks and are associated with concerns about 'high-grading', discarding and under-the-table sales pointing to the need for investment in often intensive monitory, the privatization of public resources, and, related to this, the exclusion of adjacent communities as well as future generations from access to the resource and the wealth it generates (Copes 1986, Apostle *et al.,* 2002; Bromley 2009; Wiber *et al.,* 2009; Sumaila 2010).

Some key informants especially municipal and local community stakeholders supported bottom-up approaches through, for instance, community-based quotas and management. As suggested by one respondent in St. John's with experience in natural resources management and community planning: "There needs to be dialogue and discussion [on these issues]. If a government wanted to solve a lot of rural problems, why couldn't some of the wealth coming from the fish stocks come back to these communities?" However, those associated with this perspectives have to confront the question of when and where these are appropriate or would be accepted (harvesters in a community that has a natural or technological advantage in a competitive fishery are unlikely to support a community quota system), concerns that non-fishery community groups will use this as a way to gain access to fish resources, and the opposing interests of large corporate offshore fleets (Dean 2001; Ommer *et al.,* 2007; Wiber *et al.,* 2010).

Quotes from some key informants (mainly fish harvesters, processors, and community planners) suggest fatalism is widespread. Those who are fatalistic about the future of the cod fishery and the industry in general in the region are guided, to varying degrees, by a local and larger scale sense of the ongoing fragility of the industry related to global markets, rising fishing costs, etc (see Clift and Team, 2011). This perspective is also framed by ongoing uncertainty about 'if' and 'why' the cod stocks are not recovering and concerns about ecosystem change and political will. There are also misgivings that cod recovery could jeopardize shrimp incomes (among shrimp harvesters) and about other equity and allocation issues. For some of these pessimists, the best way to deal with high risk and uncertainty is through rationalization and privatization. Others, while distrustful, would prefer changes more suited to local communities. But even these proponents are aware that the virtual absence of young people entering the industry will inevitably bring about the demise of the industry, as quota trading goes beyond provincial and national jurisdictions.

The spaces and boundaries available for the formulation of clumsy solutions are strongly influenced by social relations and, to be effective, clumsy solutions need to be sensitive to the various dimensions and multiple forms of power and how they interact. Moreover, clumsy solutions that encourage multi-level collaboration and governance networks amongst stakeholder groups at various scales are essential for effective stakeholder partnerships (see Berkes 2002; McCay 2002; Pascual-Fernandez *et al.*, 2005; Hartley, 2010).

A clumsy solutions approach seeks to address issues of power and vested interest by including and seeking to accommodate to some degree concerns of those with multiple viewpoints. It seeks to create or enhance existing 'fields of opportunity' for collaboration and to devise adaptive strategies appropriate for multiple scales through which it would be possible to implement changes that are cost effective but also responsive to uncertainty and equity concerns. Clumsy solution approaches are also relevant in order to reduce on the political risks that may arise due to social injustice, marginalization, and inequitable distribution of resource benefits through broader agenda setting. Through such an approach, scale mismatches in fisheries are also dealt with through collaborative decision-making, knowledge sharing, and bottom-up implementation strategies that may complement the top down approach. Policy formulation towards rebuilding in this context strives to include diverse stakeholder values and to negotiate hard choices especially for resource dependent communities. These deliberations need to incorporate fundamental governing principles, such as fairness, legitimacy, efficiency, effectiveness, and precaution. These principles are evident in the various cultural paradigms associated with different schools of thought on resource management (individualism, egalitarianism, hierarchy, and fatalism) and each has an element of wisdom associated with it. The precautionary principle, as advocated by international policy instruments such as the Code of Conduct for Responsible Fisheries is relevant in dealing with issues of uncertainties and fatalisms not only in the ecological and economic systems, but also with institutional and organizational structures.

Clumsy solutions that could be adapted for fisheries rebuilding

In this section, we provide a few examples of potential clumsy solutions from Canada and the US, based on community governance models that combine the basic governing principles of efficiency, fairness, legitimacy, precaution, effectiveness, as well as stakeholder partnerships in an effort to achieve sustainable seafood production, regional economic development, equity and the capacity to deal with uncertainty. Although most of these examples are recent, they illustrate the importance of institutional partnerships along the fish chain, in addition to an approach to broader agenda setting that recognizes various stakeholder values. The governing options associated with clumsy solutions speak to Ostrom's (1990) notion of self organization by community partners in resource management. These new governance approaches thus recognize the need to engage a wider set of stakeholders beyond fishing firms or industry groups and including diverse community and regional interests as well as the need to develop institutions with the capacity to adapt to uncertainty at various spatial, temporal and organizational scales (Perry and Ommer 2003; Cumming *et al.,* 2006).

Key informants identified accountability, transparency and trust as essential for rebuilding not only at the local community level, but also at provincial and federal administrative levels. Leadership and effective communication were additionally identified by some stakeholder informants as necessary for local community governance and in long term planning. A former civil servant observed: "There's absolutely no leadership left in the industry. That is not meant to be critical, but what the industry needs is leadership. It's got to start with governance in a public policy context."

In NL, the Saint Anthony Basin Resources Inc. (SABRI) is an example of a unique model of community-based governance based on the principles of fairness, inclusiveness, efficiency, and legitimacy that grew out of regional and federal level leadership. SABRI was formed post-collapse as a community-based organization in 1997 with a regional shrimp allocation quota and a volunteer-run management board[27]. The initiative behind SABRI was spurred by a quota allocation by the Minister of Fisheries and Oceans, that led to partnership arrangements with seafood processing plants based on a royalty scheme. This regional quota allocation policy was mandated to deal with fishing dependent communities and to empower local communities for regional economic development. Through its shared partnership model with Clearwater Fine

[27] http://www.sabrinl.com/Background.html last accessed July 21st 2011

Foods (private industry group), and run by a volunteer board of directors, SABRI has invested in its community through infrastructure development of cold storage and seafood marketing, initiatives in support of fisheries development, providing income earning opportunities, in addition to community enterprises in the region (GNPFT 2006; Sinclair & Neis 2008). Additionally, SABRI strives towards capacity building and leadership training to respond to labour market concerns and integrated management.

The North Pacific Fisheries Management Council in the US established the Community Development Quota program in 1992, which allocated a fraction of the annual fish harvest (mostly from groundfisheries, halibut and crab) to six mostly indigenous fishing villages in western Alaska. After more than ten years, "the results include more than 110 million USD in wages, education and training benefits for more than 25,000 residents, as well as new docks, harbors and seafood processing centers (Ecotrust 2011:3). We argue that including the various governing principles of equity, legitimacy, efficiency, effectiveness, and precaution in decision-making especially for adjacent coastal communities that are marginalized speak to the premise of clumsy solutions where diverse viewpoints and stakeholder partnerships are a win-win.

Stronger linkages between stakeholders in relation to efforts to identify local niche markets and direct benefits to local economies are one potential way to promote rebuilding in the context of resource constraint; by increasing the wealth generated from the fish landed, and through direct community involvement. Stakeholder engagement and greater access to information and knowledge along the fish chain mainly related to price and seafood market conditions are required for the development of trust and coordination, and for developing new value addition strategies. For example, stakeholder arrangements that grew out of community-based governance initiatives were crucial in setting the stage for the development of 'harvest cooperatives' or 'sectors' after the collapse of the cod fishery in New England (Holland and Wiersma, 2010). A notable example is in Maine, one of the first community-supported fisheries in New England. This started as a fisher association in Port Clyde in 2007 and later became a cooperative called the Midcoast's Fishermen's Cooperative in 2008. The cooperative consists of local small scale fishers who have used their organization to gain more control over the marketing end of their fish chain, i.e. to creating spaces for entrepreneurship from 'sea to plate' (Frazer 2009). The cooperative promotes sustainable harvesting practices, the direct sale of fresh catch to local and now more distant consumers, and also provides wholesale and retail services to other regions.

An example of a Canadian community supported fishery initiative that was developed after and with input from the Port Clyde example is 'Off the Hook' in the Bay of Fundy in Nova Scotia. Off the Hook is a good example of an institutional partnership between fish harvesters and the community (and with support from an environmental agency – the Ecology Action Centre). By providing a weekly share of fresh fish to local consumers at a premium price paid prior to the season, is helping to support small scale fishers and, to some degree, local economies[28]. These and other fish harvesters who are interested in sustainable harvesting practices, marketing their fish to local consumers, in addition to seasonal eco-tourism activities, can use these approaches to promote stewardship, food security, and community development.

These and other new initiatives for partnerships, and new financial mechanisms such as micro-finance and revolving loans, could change the field of opportunities for economic diversification within fisheries and for promoting fishery tourism synergies which could potentially sustain fisheries at the community level (see CURRA 2010). There would, however, be longer term challenges including maintaining these new institutional structures, especially in light of ecosystem changes, ongoing resource scarcity, and global seafood market fluctuations.

[28] http://www.offthehookcsf.ca/ last accessed April 26th 2010

The biggest problem with attaining clumsy solutions is probably constraints on the financial and technical resources, as well as the influence of powerful groups, and the challenges associated with dealing with a policy framework that is not well designed for such exploratory solutions. If they are to become more widespread and models for sustaining fisheries, it is likely that cooptation or other leadership and capacity building initiatives are likely play a key role in outcomes. As underscored by one key informant, a community and regional planner: "…You can't have ten people in the room wanting ten different ways of doing something and expect to get it. You [a]ll need to be at the table together and they all got to give and take."

However, one of the problems in the Northern Gulf fishery has been limited space at the table for different perspectives and options. Drawing upon John Gaventa's multi-dimensional structure (Gaventa 1980, 2006), the state is not always a neutral player. As indeed documented, the state has arguably not been a neutral player in the wake of the collapse of the Northern Gulf stocks. But its new programs, new actors- like environmental groups – and changing markets and local contexts have the potential to create spaces of opportunity for change that can, if conditions are right, including leadership, could potentially start to create new coalitions and governing options

Conclusion

The many examples of failed management leading to the collapse and stalled rebuilding of the groundfisheries in Atlantic Canada (Wappel 2005; Best 2010; FRCC 2011), illustrate that the central management model is incapable of dealing with human dimension concerns and the multi-scale institutional mechanisms fundamental to rebuilding. The analysis of the Northern Gulf cod fisheries pre- and post-collapse using Gaventa's power cube (Gaventa 2006) points to the role of power relations in opening up and closing off spaces and creating fields of opportunity for successful rebuilding strategies along various stages of the fish chain. Successful rebuilding depends on certain conditions, including broad-based governing approaches, stakeholder partnerships, and appropriate institutional mechanisms that go beyond management panaceas to creating the spaces for clumsy solutions. In the case for Northern Gulf cod fisheries rebuilding, the industrial model is the option that is on the table (with a combination of individualism through ITQs and state intervention through downsizing) and there has been little space to take into account community interests, rural development, and planning for the future and intergenerational equity.

Findings indicate that the intergenerational question of 'rebuilding for whom' is fundamental to local stewardship, secure access for community participation, and compliance. Shared stewardship and community-based governance approaches were identified by stakeholders as necessary ingredients for dealing with issues of scale mis-matches, stakeholder resistance, and the high level of uncertainties in global markets and marine ecosystems. Scientific uncertainty regarding stock migration and mixing, and the lack of rebuilding targets to evaluate stock status necessitates governance arrangements and stakeholder collaboration on shared principles and values.

Some examples that exemplify clumsy solutions in fisheries rebuilding include various community supported fisheries, community catch shares, and quota allocation schemes as practiced in different parts of North America (GNPFT 2006; Ecotrust 2011; Holland and Wiersma, 2010). Initiatives of this kind, with the exception of SABRI, are currently hard to find in the Northern Gulf of St. Lawrence. These initiatives take the form of community-based governance approaches that integrate principles of efficiency, equity, legitimacy and empowerment in rebuilding and sustaining the resource. In addition, options exist to shorten fish chains by creating new and different niche markets justified on the basis of promoting food security and livelihood security in fishing communities as demonstrated by 'Off the Hook' in Nova Scotia. Another option is to seek regional markets that entail value addition opportunities. These options require that stakeholders be at the table to create new opportunities and contribute to larger goals beyond fisheries rebuilding.

In conclusion, attention to governance, including power relations, is critical to the development of successful rebuilding strategies. One way to do this is through identifying and experimenting with clumsy solutions. These solutions can take advantage of currently limited fields of opportunity and have the potential to expand these fields and to create new ones. They are however likely, at least in the short term, to meet substantial resistance from groups with vested interests. These types of solutions can provide the basis for actions that are collective, inclusive, transparent, equitable, and that allow for social learning and adaptive governance. They are also essential for moving past stalled rebuilding towards sustainable and precautionary fisheries especially for uncertain times.

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Chapter VI: A Fish Chain Analysis of Wicked Rebuilding Problems: Synthesis and Policy Implications

Introduction[29]

As argued in the preceding chapters, there is mounting evidence that fishery resources on both local and global levels need to be better governed for ecological sustainability, socioeconomic viability, food security, and for the cultural meanings they generate. Recent estimates from the Food and Agricultural Organization (FAO) of the United Nations indicate that about 80% of seafood production is coming from fully exploited and overexploited fisheries (FAO, 2010). This status of global commercial fisheries presents a rebuilding imperative for current society-at-large, as well as for future generations. Worm *et al.* (2009) estimated that about 67% of global commercial species, including the Atlantic cod stocks (*Gadus morhua*) in eastern Canada, require rebuilding. Despite several restructuring measures, none of the Atlantic cod stocks have rebounded to historical catch levels, causing further concerns about fishing livelihoods and coastal community survival.

This thesis commenced with a global review and synthesis of rebuilding challenges and opportunities that highlighted the need for a rebuilding imperative. Examples of rebuilding success and challenges illustrate that in addition to ecological constraints, socioeconomic and sociopolitical issues are barriers to fisheries rebuilding. Rebuilding collapsed fisheries is a particularly wicked problem because of the multiple interlinkages within these social-ecological systems and the broader connections between the environment, the economy and society. Given this complexity and the common reliance to date on management panaceas, it is not surprising

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that the Northern Gulf cod have not recovered, and that only about 1% of the world's fisheries have been rebuilt (FAO, 2010).

The main body of the thesis (Chapters III to V) consists of a detailed analysis of the collapse and stalled rebuilding of the Northern Gulf cod fish chain. I employ the 'fish chain' approach to understand the various production stages and their interactions (Bavinck *et al.,* 2005; Thorpe *et al.,* 2005). The approach examines the whole production chain starting from marine ecosystems at the pre-harvest, fishing activities, processing, marketing, to consumption, and governing interactions across the chain. Moreover, comparing the fish chain pre- and post-collapse provides an opportunity to assess ecological functions, socioeconomic impacts, policy changes, equity and power dynamics, and current governing challenges and future options.

Empirical findings from the case study show that successful rebuilding will require not only the monitoring of the marine ecosystem for stock growth but also attention to other components of the fish chain. Ecological constraints in the pre-harvest stages can be mediated by institutional mechanisms that foster compliance and stewardship through equitable allocation and restructuring measures that are cognizant of social justice and coastal community needs. Moreover, addressing by-catch and discards issues through stewardship and participatory measures is necessary for sustainable gear use policy. Bottom- up initiatives and other community-based governance initiatives can be useful at the local and regional level. For example, regional quotas and stakeholder involvement through shared stewardship and community development have paved the way for partnership initiatives such as SABRI in Newfoundland, Community Development Quota programs in Alaska, and community supported fisheries such as the Port Clyde harvest cooperative in Maine.

The main contribution of this thesis lies in the use of the interactive governance theory and a 'fish chain' approach to develop a holistic perspective on fishery systems. I conceptualize fisheries collapse and rebuilding challenges as wicked problems. According to Rittel and Webber (1973), wicked problems are complex, persistent or reoccurring, often hard to detect and to fix, partly because they are linked to broader social issues. In fisheries and coastal zones, the problems go beyond scientific and technical solutions and extend to socioeconomic and policy issues (Jentoft and Chuenpagdee 2009). Fisheries rebuilding is wicked and challenging because they entail complex ecosystems, stakeholder interests, dynamic seafood markets, and multi-scaled governing institutions. Rebuilding also necessitates consideration of current and future generations, because of demographic changes, and the timescale for the recovery of long lived species such as cod (see Hutchings, 2000; Sumaila, 2004). An analytical and methodological approach that is holistic and systematic is necessary to understand wicked rebuilding problems and to explore possible governing options.

Governance approaches, rather than management panaceas, have potential to deal with rebuilding challenges, as they draw upon interdisciplinary scholarship and perspectives from diverse stakeholders groups (Gray, 2005; Kooiman *et al.,* 2005; Dietz *et al.,* 2003; Folke *et al.,* 2005; Armitage *et al.,* 2007; Ommer *et al.,* 2007). Governance approaches are also central to collaboration and inclusive decision-making, which may foster compliance, social learning, and institutional innovation. The Northern Gulf cod case study substantiates that top-down management and technical panaceas are inappropriate and have often failed to rebuild fisheries. Fish chains for commercial species such as cod are highly complex and the production stages spans beyond national jurisdictions to global markets, hence rebuilding requires holistic perspective that are interdisciplinary, participatory, and involves both state and non-state actors.

This synthesis chapter provides a summary of the key findings along the fish chain for Northern Gulf cod, starting with the pre-harvest, harvest and then post-harvest, and ends with governing interactions. Recommendations for rebuilding Northern Gulf cod fisheries are discussed and the chapter concludes with limitations and future work.

Summary findings

Pre-harvest stage

As discussed in Chapters III, key informants identified four main factors in the marine ecosystems that potentially limit the recovery of the Northern Gulf cod stocks: i) low levels of recruitment; ii) poor growth rate and low ecosystem productivity; iii) environmental changes; and iv) shift in predator-prey relationships.

According to DFO (2010) scientific assessments, recruitment for the Northern Gulf cod stocks for age 3+ cohorts have decreased from an estimated historical high of 206,000 tonnes in 1980 to about 13,000 tonnes in 2008 (DFO, 2010). Several scientific factors have been identified that may have contributed to recruitment failure. These factors include poor breeding success rates at lower populations because of density dependent factors (Bennett, 2008), ecosystem changes that affect cod predation rates by seals (Morissette *et al.*, 2009), and an increase in predation rates on small target populations (see Liermann and Hilborn 2001; Walters and Kitchell 2001).

Depensation effects or recruitment failure are a major limiting factor for stock recovery (Rowe *et al.*, 2004; Hutchings and Myers, 1994; Myers *et al.,* 1995). Additionally, genetic and evolutionary effects may have negative implications for stock recovery as emphasized by one key informant- a senior research scientist. Extreme cold weather patterns have been shown to affect growth rates and the condition factor of fish in the Northern Gulf (Frechet, 1990; Hamilton *et al.,* 2004; Gailbraith, 2006). Moreover, regime shifts from cod-dominated food webs to invertebrates tend to prolong recovery timeframes for groundfish species as these affect their growth rates (Ratz *et al*., 2003; Bundy *et al.,* 2009; Morissette *et al.,* 2009). The increasing abundance of seals and their high predation rates was another limiting factor highlighted by key informants.

Harvest stage

Key limiting factors for rebuilding at the harvest stage can be classified into three main categories, as discussed in Chapters III and IV: i) ineffective fishing policies that perpetuate livelihood, social justice and dependency concerns; ii) continuous fishing mortality; and iii) by-catch and allocation policies that have ramifications for resource sustainability and stewardship.

Analyses of both primary and secondary information showed that previous restructuring initiatives have been ineffective and unsuccessful towards creating alternative livelihood programs. These shortcomings in restructuring outcomes led to the termination of public funding for adjustment programs as authorized by the Auditor General (Rice *et al.,* 2003; ACOA, 2004; Best, 2009). As discussed in Chapter III, restructuring programs such as vessel buybacks were devoid of rural planning considerations, and targeted inshore fixed gear fleets, which have lower fishing capacity and are more embedded in the local economy (Holland *et al.,* 1997). These missed opportunities for developing equitable and effective fisheries policies have exacerbated allocation concerns and created uncertainties for inshore fishers and fishing dependent communities about what will happen in the event of full recovery.

In the pre-collapse period, allocation quotas and support were given to the mobile fleets, providing them with opportunities to 'follow the fish' and to engage in unsustainable fishing practices including high-grading and 'under the table sales' (Palmer and Sinclair, 1997). Historically post 1977, about 40% of the TAC was allocated to mobile dragger fleets, and the remaining 60% allocated to fixed gear inshore fish harvesters and a small fraction to foreign fleets notably St. Pierre and Miquelon. As total allowable catch (TAC) quotas reached a historical high in 1983 at 100,000 tonnes and steadily declined till the early 1990s, a complete moratorium was instituted from 1994 to 1996 and again in 2003 (DFO 2010). This was followed by a reduction in the TAC in the post-collapse periods for a small-scale inshore commercial and recreational fishery. The TAC has ranged from 3,500 to 7,000 tonnes and is currently set at 2,000 tonnes for 2011. There are stakeholder concerns that an increase in stock abundance beyond the 9,000 tonnes TAC may warrant new allocation arrangements to allow the mobile dragger fleets to follow the fish through its spawning and feeding migration routes as in the pre-collapse periods.

Youth involvement in the current fishery is central for local stewardship and addressing the question of 'rebuilding for whom' and who would benefit when the stocks recover especially with an aging adult population and current demographic trends. This was a major theme identified by the various stakeholder groups along the fish chain, and a necessary consideration for community stewardship and regional economic development. Additionally, the Professionalization Act in 1997 has ramifications for distributional and procedural equity especially for an aging adult population and for the 'rebuilding for whom' question. These concerns are well captured by a key informant:

> 'Our [fisher] demographics now are 55 and older…We have a real problem with that, we have to find a way to get people back in to the boats. But how do you do it, what is fair? Is it fair to say, say Peter's grandmother, at the end of it, gets nothing. She is going to

retire because the plant has closed up, that woman deserves Canada pension and old age security... I think that there is an opportunity now for these older people; it's not going to cost billions, just a [retirement] package. Then the bigger question is who is going to go in there? We have huge problems with the fact that it's access to capital [for young entrants]. .It's not only the cost of the boat, but you have to buy the licenses. If you are talking about large boat crab, it's going to cost a million… and you have to pay it back in 5 years, it's a lifetime investment.'

Most of the fish harvesters interviewed in the NAFO region 3Pn (about five in total), underscored mis-matches in stock migration patterns, fishing activities, and spatial management boundaries; another reason for stalled rebuilding. To illustrate, Northern Gulf stocks that migrate to the 3Ps region may be susceptible to winter fishing as observed by both scientists and fishers alike. These concerns have been reported earlier through knowledge mapping by Murray *et al.* (2008) and tagging experiments by Yvelin *et al.* (2005) and Methot *et al.* (2005). These mis-matches present scope for research and development through interdisciplinary collaboration and knowledge mobilization that is essential for stewardship and rebuilding success.

AS discusses in Chapters III and IV, gear impacts and by-catch issues remain by far one of the most complex management challenges for cod fishery rebuilding according to key informants (see DFO, 2010). Management measures for by-catch restrictions vary by gear types, species targeted, and NAFO management areas in the Gulf of St. Lawrence. Interviews with fish harvesters on by-catch policies revealed that conservation incentives are necessary for accurate reporting. Crew-sharing relationships with skippers have undergone changes; from more equal sharing of revenue to wage labour that is unsatisfactory and often supplemented by government transfers (Schrank 2005). According to key informants such as majors and fish harvesters who live in fishing communities, these changes affect local capacity for rebuilding and also affect labour market and youth retention in coastal fishing communities.

Post-harvest stage

Three rebuilding challenges were identified by stakeholders in the post-harvest stage. These include: i) current seafood production chains are driven by consumers and retailers through eco-certification and chain of custody rules; ii) product substitution and global seafood market dynamics often mask resource supply constraints; and iii) institutional rigidities constrain policy initiatives and stakeholder buy-in towards rebuilding strategies.

As discussed in Chapter IV, the supply chain has transitioned from state involvement with seafood producers, to transnational retail stores through various consumer-based incentives such as eco-certification schemes by the Marine Stewardship Council (MSC). One key informant, a cod processor, emphasized the stringent chain of custody requirements that affect price premium opportunities and consumer preference for cod fillets in the current UK markets. Another processor of forage fish and shellfisheries, complained about the provincial minimum processing requirement policy, which stymies product development and innovation for niche markets. The shift in marketing power from producer-driven chains in the pre-collapse era to consumer-driven chains and transnational retail stores in the post-collapse era require broad based governance mechanisms for compliance and stewardship. In addition, the certification of Pacific cod (*Gadus macrocephalus*) by MSC, for instance, could affect market share for Atlantic cod stocks upon full recovery. Since post-collapse, Alaskan Pollock (*Theregra chalcogramma*), a certified fishery by MSC, has replaced the block cod market in the US, which used to be the primary markets for Newfoundland seafood (Kirby, 1982; Wright, 2002). Key informants, mainly processors and retailers, complained that most of the secondary processing for seafood is outsourced to China, with little branding or marketing initiatives in the province (see Roche, 2008). Cheaper substitutes such as tilapia (*Tilapia spp*) have flooded the white fish market in North America (Asche and Smith, 2010), which may affect the economic viability for cod and other groundfisheries upon full recovery.

Changing market and macroeconomic factors such as tariffs, trade barriers, and exchange rates impact global seafood trade and the viability of local fisheries (Moore *et al.*, 1993). Key informants in the fishing industry drew attention to several market factors that affect economic viability including high fuel costs, debts, and inequitable distribution of revenue along the marketing chain as shown in Figure 6 Chapter IV. Resource constraints for cod fisheries and changing markets towards high value shellfisheries pose considerable challenge for long-term investments in groundfisheries rebuilding. These factors highlight the governance challenges along the fish chain and call for broader engagement for the fishing industry and civil society groups in collective decision-making for economic viability and stewardship initiatives.

Yet, global seafood dynamics and market considerations have not been included in the institutional and policy process towards rebuilding (DFO, 2010b). This lack of market consideration in previous rebuilding strategies emphasizes the relevance of the backward bending nature of seafood production, especially in the absence of effective institutions (Copes, 1970; Gudmundsson *et al.,* 2006). Institutionally, the SARA process is devoid of non-market valuation for ecosystem services and cultural benefits, which are essential for mobilizing broader stakeholder support for recovery action plans. Various examples from around the world have shown that non-market valuations are important considerations towards rebuilding strategies (Sumaila and Suatoni, 2006; Ojea and Loureiro, 2010). These considerations may have an effect on support from conservation campaigns such as SeaChoice[30], and influence consumer choice towards eco-friendly products.

Governing institutions and their interactions

Despite the plethora of institutions and agencies responsible for fisheries rebuilding in the Northern Gulf and eastern Canada as a whole, findings indicate that there are concerns about poor stock status and corresponding livelihood security. Two main limiting factors can be identified as discussed in Chapters III to V: i) poor institutional linkages and a lack of multi-level governance arrangements; and, ii) top down management measures that are non-participatory and lack regional economic development dimensions.

Although stakeholders along the fish chain are interacting on a day-to-day basis both formally and informally, several policy concerns were identified regarding price setting mechanisms, revenue distribution along the marketing chain, and multispecies harvesting. These inconsistencies if unaddressed may have consequences for successful rebuilding and economic viability. Moreover, there are disconnects between the federal SARA policy process, the federal-provincial taskforce recommendations, and the regional taskforce initiatives. According to a community planning and regional policy analyst: "What we need now is synergy, synergy in terms of collaborative processes and partnership amongst institutions and multiple stakeholder groups… to share diverse views because none of the existing solutions will work". These governing interactions in the midst of power imbalance are reflected in the persistence of protests related to fisheries closures, reductions in TACs, and over the bargaining of fish prices. This highlights the advantages of clumsy solutions, as they tap into these various perspectives, reduce the risk of regulatory capture by powerful groups and can help to address equity and social

[30]SeaChoice menu listings http://www.seachoice.org/profile/result?rating=3 last accessed July 10, 2010.

justice concerns. The clumsy solution approach advocates for broader agenda setting opportunities rather than see stakeholder interests as conflicting objectives. The multiple conflicting perspectives as practiced under the fisheries management paradigm; often lead to equity concerns, the marginalization of some groups, and political risks in decision-making.

Key findings suggest that inclusive decision-making and multi-level governance arrangements are critical to address scale mismatches and to foster new governing initiatives that address sustainable fishing practices, distributional and intergenerational equity, and regional development. However, poor responsiveness, lack of leadership, bureaucratic inefficiencies, and poor stakeholder involvement at various scales along the fish chain were identified by key informants as constraints on successful rebuilding. For instance, the capacity adjustment programs implemented after collapse were devoid of long-term rural planning goals, community involvement, and broader regional economic development considerations (ACOA, 2005; Sinclair and Neis, 2008; Vodden, 2009). In addition, interview responses from policy-makers and research analysts suggest that lessons from these past policy failures have not been fully incorporated into present strategies, as reflected in the recent report on the Memorandum of Understand (MOU) by Clift and Team (2011). This lack of synergy between rebuilding, restructuring, and community planning is captured by this quote from a retired civil servant discussing the MOU report of the provincial government: "the MOU process addresses itself to capacity, reduction of capacity [only]. The big issue of rebuilding is put on the back burner…You have to really look at the question of rebuilding. Clyde Jackman's MOU only deals with one side of the equation. The experience that we've had in government with capacity reduction is not good." These social learning opportunities for government from user participation and institutional partnerships are relevant for public awareness and support, industry buy-in, and collaboration of stakeholders and government agencies (Jentoft and McCay, 1995).

In comparison to other rebuilding efforts in Europe, Asia and Oceania, the recovery success of four commercial species in the US reveals three critical features of fisheries governance. First, there are clear legal mandates for recovery and rebuilding under the Endangered Species and Sustainable Fisheries Acts, respectively (Wakeford *et al.,* 2009); in addition to other Acts such as the Marine Mammal Protection Act and the Coastal Zone Management Act. Second, there are harvest control rules and target reference points to monitor and evaluate stock rebuilding performance, with various participatory mechanisms to address uncertainties especially from fish harvesters and environmental conservation groups (Caddy and Agnew, 2005). Third, regional management councils help to address spatial governance concerns through amendment of the fisheries management plans (if necessary), dealing with socioeconomic and equity concerns, and creating policy dialogue for buy-in and cooperation amongst stakeholders (NEFMC, 2008; Hanna, 2010).

Recommendations for successful rebuilding

Rebuilding challenges are also opportunities for exploring governing options as discussed in Chapters II to V. Based on the limitations identified in the previous section, four thematic opportunities were recommended by key informants:

I. recommendations for ecosystem-based management approaches by research scientists and fish harvesters;

II. recommendations for vertical linkages for economic viability by various industry partners mostly by fishers, processors, and retailers;

III. recommendations for horizontal linkages and multi-level governance initiatives by managers, community planners, and municipal leaders; and

IV. recommendations for institutional innovation and the creation of new fields of opportunities by community planners, civil servants, managers, and members in the fishing industry.

Ecosystem-based approaches to fisheries rebuilding

Key informants, especially managers and scientists, emphasized the benefits of ecosystem approaches to fisheries, which entail multispecies approaches with attention to predator-prey interactions, reliance on precautionary principles, stakeholder involvement, and adaptive governance (Ommer *et al.,* 2007; Vodden, 2009). These considerations, in addition, to an institutional design that considers stakeholder partnership are necessary to deal with ecological constraints for the successful recovery of Northern Gulf cod fisheries as documented in various task force reports (example Government of Newfoundland and Labrador, 2003). Key informants highlighted the relevance of research and knowledge of harvest rates for cod, and on the ecosystem role of capelin and herring in stock recovery. Empowering community partners through active involvement of local stakeholders in stewardship as well as co-management arrangements were proposed by key informants.

Ineffective restructuring policies (e.g. vessel buybacks and license retirement programs) have implications towards livelihoods for fishing dependent communities and the sustainability of the resource. These socioeconomic considerations are consistent with an ecosystem-based paradigm and part of the social-ecological approach to rebuilding. Policy innovations on proactive measures and long-term planning are recommended by key informants to counter the reactive measures for regional economic planning, labour markets, and ecological resilience.

Monitoring fisheries rebuilding across the three stages of the fish chain is central to successful recovery. In addition to standard stock recovery indicators such as spawning stock biomass (see Froese and Proelb, 2010), considerations towards trophodynamic indicators are essential for monitoring stocks and ecosystem restoration programs (see Pitcher, 2001; Cury *et al.,* 2005; Pauly and Watson 2005). Moreover, broad sets of policy and governance indicators on the economic, social, and cultural attributes are essential for effective feedback and institutional responses. This broad set of indicators is useful in evaluating rebuilding along the entire fish chain from an ecosystem-based perspective.

Knowledge gaps about stock migration patterns, critical habitats, and stock mixing in the Northern Gulf region pose new research opportunities; and fields of opportunity for knowledge synthesis and policies that are better suited to the natural systems. Fishers in the 3Pn region for instance, have been very instrumental in management initiatives such as limiting harvesting in their area to hook and line fishing gear, and implementing a seasonal closure in St. Georges Bay to protect spawning cod stocks. Similar lessons have been learned from Gilbert Bay in Labrador where local community partnership of fishers and DFO have led to protected areas for rebuilding offshore spawning grounds (Wroblewski *et al.*, 2005). Harvesters suggested ways their cultural and historical knowledge of their lives at sea and fishing activities could contribute to data gathering (catch-per-unit effort), fish tagging and recapture, sentinel fishery, stewardship initiatives, and partners in decision-making. Finally, stewardship plays an essential role in stock recovery (Blanchard, 2010), as demonstrated by various stakeholder responses for inclusive decision-making (mayors, planners, processors), and the sharing of cost and benefits especially during the rebuilding transition period.

Vertical linkages for economic viability along the supply chain

As discussed in Chapter IV, seafood is the most traded commodity globally with dynamic and competitive markets that are affected by both demand and supply factors. According to key informants in the fishing industry notably fishers and processors, recovery initiatives that acknowledge global market factors are likely to lead to industry buy-in. Besides, the globalization of seafood prompts the need to re-examine interactions beyond the nation state, and to foster institutional linkages and international partnerships for viable and sustainable trade policies (Smith *et al.,* 2010).

Both producers and consumers influence markets through product differentiation, eco-labeling, and sustainable fishing practices. Greater interactions and strong institutional interlinkages between harvesters and their union, processor associations, brokers, wholesalers, retailers, and other policy makers can facilitate effective communication and inclusive decision-making (UNEP, 2009). Several 'focal points' along the fish chain are identified as important for supporting resource sustainability initiatives and economic viability. In the context of fisheries, these focal points include: TAC setting and allocation mechanisms, access rules, fisheries closures, dockside price setting, and rationalization measures. These focal points create avenues for protests and conflicts because of distributional issues and collective social dilemmas (Ostrom, 2000). Focal points along the fish chain require improved social relations and institutional interlinkages that might be achieved through negotiation and bargaining (see Schelling, 1960). Moreover, institutional innovation and power brokerage through clumsy solutions could remedy some of these challenges by improving supply chain coordination, market access, and regional development.

Decision making around these focal points may involve making hard or soft choices, and developing appropriate conflict resolution mechanisms, and effective communication on values and principles (Kooiman and Jentoft, 2009). Institutional partnerships are therefore necessary for supply chain coordination amongst harvesters, processors, and retailers; in order to reduce on transaction cost and enhance competitive advantage and value addition (van der Schans *et al.*, 1999). Depending on the context, short fish chains may be more ideal for food security, local retail markets, and community development; whilst longer chains for export and niche markets may play a greater role in revenue generation. As discussed in Chapter V, emerging governance models demonstrate that coastal communities are central to rebuilding and sustaining fisheries for future generations. Inshore resident fishers in coastal communities by virtue of their local knowledge of marine environments can be stewards, through equitable quota allocation based on the adjacency principle, local seafood marketing for community development, as well as regional initiatives that supports capacity building and integrated livelihood programs.

Horizontal linkages and multi-level governance

The complexity and dynamics of multiple stakeholder groups along the fish chain is further exacerbated by diverse and various administrative and organization scales. Fisheries are generally not isolated from other resource-based industries; they are linked to other maritime industries such as shipbuilding, gear making, transportation, and seafood packaging (Dyck and Sumaila, 2010). Hence there is a need for broader stakeholder collaboration through integrated coastal and marine spatial planning strategies, to deal with scale mismatches between institutional mandates to ecosystem and socioeconomic boundaries. Despite the recent budget cuts, the Integrated Management program under Canada's 2005 Ocean Strategy and *Ocean Act* provides a unique opportunity for such horizontal linkages and institutional arrangements.

According to key informants, these considerations are necessary for previous federal initiatives for large-scale ocean management area (LOMA) and provincial coastal management area initiatives. As mentioned earlier, the federal budget cuts that led to the disbandment of the FRCC and non continuation of the LOMA initiatives brought protests from leaders of the Green Party of Canada and other political entities.

The REDBs were identified by key informants as one of several initiatives that currently explore alternative livelihood options by coordinating regional economic development through various agencies and stakeholder groups. These livelihood strategies include strategic eco-tourism opportunities, value-addition and secondary processing in forestry, agri-food production, and small-scale manufacturing (Government of Newfoundland and Labrador 2003; RORB, 2008). According to municipal and community planners interviewed, the REDBs have huge potential for economic development but require adequate funding and autonomous power to implement programs and network with stakeholder groups. Key informants further emphasized the role of local community leadership in recovery efforts and fisheries in general, multi-level governance arrangements that recognize regional economic development, as well as encouraging local participation through fishing access rights and stewardship responsibilities.

Institutional innovations, fields of opportunity, and clumsy solutions

The various values and expectations of stakeholder groups along the fish chain call for effective communication and inclusive decision-making on shared goals. To rebuild the Northern Gulf cod fisheries and sustain them, more governing consideration will have to be given to power dynamics, scale issues, institutional partnerships and linkages, and community governance models for transitional livelihoods s and regional economic development. Applying Gaventa's (2005) theoretical power cube framework provides a better understanding of the role of power in the collapse and stalled rebuilding of Northern Gulf cod fisheries and also offers insights into how stakeholders might create new spaces and 'fields of opportunity' for rebuilding. Power is also central to clumsy solutions and governing options as some powerful and resourceful groups have to give ground to allow the creation of new ways of doing things that are inclusive of other viewpoints. Clumsy solutions draw on diverse stakeholder perspectives and prompt us to think about inclusive decision-making, integrated livelihood strategies, equitable distribution, and establishing effective institutional mechanisms.

Some key informants complained that the various governing institutions often work in silos and are very rigid, highlighting concerns about policy coherence and synergy between federal and provincial government agencies and various stakeholder groups. Decision-making structures in the pre-collapse era, for instance, contributed to power differentials and regulatory failure by providing more resources to the offshore mobile fleets through government subsidies as well as allocation mechanisms for boat quotas that led to overfishing and unsustainable fishing practices (Palmer and Sinclair, 1997).

Moreover, fostering participatory decision-making and institutional innovation are central to the rebuilding imperative as discussed in Chapter II. This may require also paying attention to governing principles, such as the principle of adjacency that may address community concerns about livelihood, cultural heritage, and institutional capacity (see McCay and Jentoft, 1995; Davis and Wagner, 2006). However, current approaches that emphasize management panaceas or 'one size fits all solutions' are inadequate to deal with the multifaceted problems associated with wicked rebuilding problems. As argued in Chapter II and V, bringing together these isolated ideas from stakeholder groups may provide broad participation and may necessitate 'clumsy' solutions that tap into wider experiences. Examples of clumsy solutions that draw on diverse stakeholder perspectives may include knowledge synthesis, integrated livelihoods, capacity building, community governance initiatives, and public-private partnerships for seafood production.

Various governance models are emerging to deal with resource collapse, community viability, and the need for stewardship initiatives at various spatial scales. These emerging governance models speak to a combination of governing principles that include efficiency, effectiveness, legitimacy, equity and precaution that are often embedded in single management paradigms. Some notable examples include Community Development Quota programs in Alaska (Ecotrust, 2011), Cape Cod Fisheries Trust and Harvest Cooperatives (Holland and Wiersma, 2010; Ecotrust, 2011), regional quota allocations to the St. Anthony Basin Resources Inc. (SABRI) towards regional economic development initiatives, and Community Supported Fisheries such as Off the Hook as practiced in Nova Scotia. These community governing models are instrumental in learning how to deal with resource collapse in the Northern Gulf, especially with restructuring and equity issues, livelihood security, and fostering community development and empowerment, and cultural heritage.

Limitations and future work

The research design for this thesis draws on the fish chain approach that considers local, regional, and global perspectives on rebuilding options. The Northern Gulf cod fisheries provide an exemplary case study of a collapsed fishery that has many stakeholder groups, and is governed by multiple institutions including provincial and federal agencies and a regional management organization. In addition to the policy document analyses and statistical data, the key informant interviews were very important in highlighting management constraints and potential governing opportunities for rebuilding.

A major limitation of this research however, is the inability to get key informants' perspectives from the foreign fleet sector, international seafood retailers, and consumers. Furthermore, it was difficult to interact with key informants in the foreign fleet sector and international seafood retailers in the study region, except for interview responses and discussions with key informants who have dealt with them in the past. The design of the research methodology, in dealing with temporal time horizons in the pre- and post-collapse periods, also limited the contribution of youths as key informants. This creates a knowledge gap on the potential role they might play in community empowerment for fisheries rebuilding. The unavailability of cost information incurred by processors, brokers and retailers was the biggest setback in computing value-added benefits for the entire market chain actors.

Future research needs to pay attention to these limitations and to coordinate focus group sessions and policy scenarios on governing options. These holistic approaches can provide a platform to deliberate on varying harvest rates, predator-prey relationships in multispecies fisheries, biophysical and climate anomalies. Exploring policy scenarios with stakeholders on TAC allocation mechanisms, consumer markets, power arrangements, and choices of policy instruments are necessary for effective buy-in and the negotiation of rebuilding tasks and responsibilities across the entire fish chain.

Recognizing institutional inertia, power dynamics, equity, and trust issues amongst stakeholders in the Northern Gulf region; how likely is it for alternative governing options to be implemented for rebuilding? This is a question that warrants theoretical development and empirical research. The interactive governance theory, upon which the fish chain approach was drawn, provides future research opportunities for better understanding the challenges around governing capacity, and the principles and values that guide stakeholders and decision-makers.

Theoretical reflections and lessons to share

The focus of this thesis has been on global fisheries collapse and the rebuilding imperative, and relying on the Northern Gulf cod fisheries as a case study to understand the bigger question of how to address wicked rebuilding problems and to sustain fisheries once rebuilt. It is a better story to tell by also reflecting on the historical context of fisheries development and management, and the profound changes in institutional structures, and global environmental and economic changes in the past century. Conceptualizing fisheries rebuilding as wicked problems highlight that there are no definite solutions to these problems, as they are persistent, multi-faceted, and linked to broader issues that goes beyond ecological changes to economic, social, political, cultural, and organizational dimensions.

It is interesting to remember that the collapse of herring fisheries in the North Sea in the late 1890s led to the formation of the International Council for the Exploration of the Seas. However, this institutional initiative did not end overfishing and subsequent stock collapses[31]. Rather, we have witnessed in the past five decades the most unsustainable fishing practices in human history, leading to a third of global fish stocks to be overexploited and depleted (Pauly *et al.,* 2002; FAO 2010). This highlights a rebuilding imperative and an alternative vision of what sustainable fisheries *should* look like (see Bundy *et al.,* 2008), and to recognize not only ecosystem functions and healthy oceans, but also to addresses issues of equitable distribution, power imbalances and regulatory capture, and effective institutional mechanisms that foster stewardship and sustainable livelihoods.

Today seafood is the most widely traded commodity globally, provides protein for more than a billion people and livelihoods for about half a billion (FAO, 2010). The growing reliance on fisheries for consumptive goods and ecosystem services warrants a political mandate and

[31] http://www.ices.dk/indexfla.asp last accessed December 21st 2011.

collective action in sustaining human welfare. However, current and previous top down management approaches practiced in many countries are highly flawed and needs rethinking (Ludwig, 2001; Pauly, 2009). These is also a growing recognition that fisheries needs to be studied through an interdisciplinary lens (see Jentoft, 2006), because of the multiple benefits it provide human societies and their economies, and also due to the normative and methodological aspects that needs to be reconciled (Song and Khan, 2011). The fish chain approach used in this thesis was an attempt to bridge these methodological gaps through a social-ecological thinking, as well as highlighting the theoretical contribution of governance approach in fisheries research. This is especially essential in the context of conflicts and protests upon fisheries collapse (Charles, 1992), and the transformative governance opportunities that emerge to do things differently (Gilcich *et al.,* 2010), even if in a clumsy manner (Khan and Neis, 2010). The biggest challenge is institutional rigidity in responding to these challenges, as evident by Newfoundland and Labrador's provincial marketing policies, which prevent direct wharf sales to local residents and institute minimum processing requirements despite increasing consumer demand and local interests for potential niche markets.

Moreover, methodological developments that bridges the social, natural, and policy sciences are highly desirable for wicked rebuilding problems, as well as taking an ecosystem approach that places humans within their natural environment. Attempts have been made to combine and couple ecosystem and value chain components into scenario modeling (Khan, 2009; Christensen *et al.,* 2010), in addition to stakeholder engagement and focus group workshops. Analytical and participatory processes are both central to policy formulation, for legitimacy and buy in from stakeholders, in addition to defining issues and goals that are socially acceptable and fair (Garcia and Charles, 2008). In the case of migratory and shared fish stocks such as tuna, this theoretical reflection highlights the merits of cooperation not only along the fish chain, but also amongst states (Munro *et al.,* 2004; Bailey *et al.,* 2010, 2011). Moreover, genuine partnership that emphasizes institutional mechanisms and power sharing models that address equity issues and multiple fisheries objectives may lead to long term resource sustainability (Petersen, 2006).

Behavioral changes through consumption patterns, education and awareness, seems to be playing a major role especially by conservation groups through seafood guides. The oversight of these efforts in rebuilding strategies is crucial to note, especially in the case of NL. The key lessons from this case study are manifold, and are worth sharing. First, it underscores not only an interdisciplinary approach to fisheries research but also taking broader governance approach that is inclusive and participatory of stakeholder groups. Second, the fish chain approach is ideal in dealing with scale mismatches, by tying in adaptive capacity and leadership needs at various spatial scales, and linking fisheries and seafood trade to broader regional contexts of integrated management and livelihood security. Recently, Gutierrez *et al.,* 2011 argued that leadership and social capital are key criteria that make co-governance fisheries models successful, this is even more necessary in regions with severe financial and technical constraints. Third, these lessons are not only for fisheries rebuilding initiatives in Canada, but are relevant to other regions where natural resources need to be conserved for the benefits of both current and future generations; as well as considerations for the small scale sector that are linked to community viability. Examples of best practices around the world on sustainable fisheries also underscore these characteristics, as evident in community based fisheries (Cunningham and Bostock, 2005; Hilborn *et al.,* 2005), co-management arrangements (Pomeroy *et al.,* 2001; Khan *et al.,* 2004; Gutierrez *et al.,* 2011), as well as quota schemes and catch shares (Costello *et al.,* 2008). These examples also buttress the need to be clumsy in our approach to governance, in order to reduce on the risk of political and institutional failure, as there are no technical fixes or easy solutions to wicked fisheries problems. Fourth, context and place matters, as what may work in one region may not necessary work in another, due to limitations in governing capacity, institutional structures and legislations, and the ability to be adaptive, flexible, and precautionary in the face of uncertainties.

Conclusion

Fisheries rebuilding requires not only temporal and spatial considerations in terms of ecosystem changes and institutional mechanisms, but also an understanding of the impacts of fishing activities and globalized seafood markets, and the role of power in creating spaces for governing options. For the Northern Gulf cod fisheries, efforts such as the Canada-provincial Cod Action Teams, industry renewal initiatives, regional taskforces, shared stewardship initiatives that include sentinel fisheries and tagging research, are all essential inputs for successful rebuilding and a sustainable industry but surely not enough in addressing issues around equity and the 'rebuilding for whom' question.

Various governing arrangements including bottom-up community initiatives, public-private partnerships, co-management, and federal-provincial partnership agreements hold promise for designing mechanisms that promotes compliance, stewardship and cooperation towards rebuilding efforts. Moreover, institutional innovations with various policy instruments that foster trust, legitimacy, inclusiveness, effectiveness, efficiency, and equity are central for rebuilding success as 'one size fits all' solutions are incapable to address these multifaceted challenges. Vertical linkages through value addition and marketing along the supply chain; and horizontal linkages through integrated coastal management and marine spatial planning are strategies that are useful to address policy disconnects and scale mis-matches.

In summary, governance mechanisms and institutional innovation are key tools to achieve the rebuilding imperative in fisheries. The fish chain provides a holistic approach for understanding rebuilding opportunities and challenges through various stakeholder perspectives that provide policy inputs for clumsy governing options. Further, a pre- and post-collapse analysis along the fish chain provides insights into ecological constraints, policy changes, stakeholder concerns, and governing options that tie in with integrated livelihoods strategies, community planning, institutional partnerships, and shared stewardship initiatives. The lessons from this case study emphasizes an inclusive and participatory approach to resource governance, as well as an interdisciplinary approach to fisheries; as stakeholders hold diverse interest, values, and knowledge that need to be understood and place on a broader agenda for policy deliberations, and for policy choices that are ethical, just and equitable.

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Appendices

Appendix I: Interview schedules

PART I

Demographic and background information

I. Age ________

II. Gender M___ F ___

III. Formal education ____________

IV. Place of residence ______________ Residence during the 1980s _____________

V. Current Profession / occupation ____________________________

PART II

Section A: Status and prospect of restored Northern Gulf cod fisheries (for all key informants)

1. Describe your career/association with the Northern Gulf cod fishery/fishing industry in Western NL
    a. When did you start,
    b. What jobs have you held,
    c. When did you hold each of them,
    d. Where were you based
    e. What did each of these jobs involve?

2. Based on your experience, describe the Northern Gulf cod fishery as you knew it in the period between the late 1980s and the closure of the cod fishery in 1993
3. Based on your experience, describe it today (focus on those parts of the fishery with which you were and are most familiar)
4. What in your view has changed since the closure? What has stayed the same?
5. Describe your understanding of the current status of the Northern Gulf cod stocks?
6. Describe your sense of the extent and nature of any recovery that has occurred to date
7. On what do you base your sense of the current status of these stocks?
8. Based on what you have seen, what has supported the recovery of the stocks? What has impeded it?
9. Describe your observations and perceptions of the current status of those other parts of the industry with which you are most familiar (harvesting, processing and marketing).
10. What would a restored fisheries look like?

Section B: Scientific information and management efforts (for managers and scientists only)

11. What are the key scientific criteria for stock recovery?
12. Are there rebuilding targets and timeframe, if not, why?
13. Are there any rebuilding target considerations to set quotas over the past decade or so?
14. In your opinion, has enough consideration been given to protecting older more fecund cod in current management initiatives?
15. What about fish larvae and juvenile cod?
16. In your opinion, how might the abundance of seals have affected recovery to date? How might it affect future recovery?
17. What about the abundance of capelin, herring and other forage fish?

18. In your opinion, are there particular kinds of habitat in the Northern Gulf that are particularly vital for cod recovery? What kinds? Do you see this habitat as threatened/in need of protection in any way?
19. When, if ever, do you expect recovery to reach historical levels (1980s)?
20. What is the extent and nature of any recovery that is likely to occur in the next 10 years and why?
21. What opportunities do you see that might help promote recovery of the stocks?
22. What barriers do you see to recovery?
23. What do you think about the stocks migrating and mixing with in other regions such as in 3Ps region in southern Newfoundland?
24. How might environmental changes such as climate change in the Gulf be affecting cod survival and recovery prospects?
25. What would happen if the water column gets too cold or too warm for cod survival?
26. What if the water column gets too acidic?
27. How are quotas set for the small-scale and recreational fisheries? Would the amount affect recovery?
28. In terms of priority, what should be the top on the agenda for recovery of Northern Gulf Cod stocks?
29. What management measures have not yet been explored since collapse?
30. How does by-catch of cod in other groundfisheries affect its recovery?
31. Are the catch adequately reported now?
32. How does the vessel and catch monitoring system works?
33. What are the key uncertainties and risks involved for fisheries recovery?

34. How possibly could they be addressed?

35. What would a recovered (sustainable) Northern Gulf cod fishery look like to you in terms of:

   a. Access and quota allocation (small boats or large boats, local or foreign licenses, etc)

   b. Participation and employment level (young, old and /or mid career fish harvesters)

   c. Markets (local, regional or international)

   d. Price, quantity and quality

   e. Other____________________

36. What would it take to get there? Prompt:

   a. From a local, regional, provincial and federal perspectives

37. What would be the benefits of recovery and who would share in those benefits?

38. What costs are essential to recovery?

39. Who should pay those costs?

40. Who would be part of this recovered fishery, planning and implementation? Prompt:

Section C: Socio-economic and livelihood concerns (for resource users only)

41. How important are the fisheries to you and your community

42. Do you wish for Northern Gulf Cod to recover?

43. How do you cope with the changes in the fishery since the groundfishery collapsed?

44. Have you change fishing locations or target species over the past 20 years?

45. Do you think that cod fish would come back?

46. Some people think because crab and shrimp are plenty, cod may not come back: what do you think?

47. What about capelin, which is food for cod; and seal, which eats cod? Do you think they may influence cod recovery?

48. How about climate change? Do you think it will affect fish migration, fish abundance or where you may fish?
49. Where do you normally land your catch and why
50. Do you get by-catch? What kind of by-catch? What do you do with it?
51. What is the percentage of crew or labour force that is part of your community, kingship and family?
52. In your opinion, how dependent are community residents on the fishery and their involvement in your enterprise?
53. Are there any education and training program available for employees?
54. How different is the share system now compared to 20 years ago?
55. How do you sell your catch?
56. Do you always report your catch?
57. How does the dockside monitoring works?
58. Is there good relationship with your buyer? For how long now?
59. How do you set price for your catch?
60. How have this changed over the years?
61. Are there options for credit within the fishery or other livelihood occupations since the first moratorium?
62. For your fishing business: do you break even, if so, what is the % of your profit margin?
63. What government interventions and policy measures benefit your livelihood?
64. What government regulation and policy measures have a negative impact on your livelihood?
65. What are the main curing methods for seafood products and where are the markets located?
66. What percentage of product supply is value added?

67. How do things work in the fish plant? Who gets assigned to do what and when?

68. Do you get to work with other fish plants or fish plant workers in other regions?

69. What percentage of the product input is trashed, wasted or of no use?

70. What are the key factors that affect distribution of seafood products?

71. what is the scale of your processing and marketing channels

    a. before collapse

    b. after collapse

72. How does the final seafood product get priced?

73. Do you collaborate with others in the fishing industry?

74. Are you a member of an association or union, how does it benefits you?

75. What are the current challenges in the fishing industry?

76. What kinds of government interventions may help you cope during recovery period?

77. How would fish trade and sustainable certification schemes affect cod recovery prospects?

Section D: Organizational decision-making (bureaucrats and decision-makers at institutional level)

78. How important are the fisheries to you and your organization/agency

79. What are your agency mandates or main aims,

80. How would your mandates affect recovery?

81. Do you think that cod fish would come back?

82. What do you think are the current challenges in cod recovery?

83. When do you expect recovery to historical levels?

84. Some people think because crab and shrimp are plenty, cod may not come back: what do you think?

85. What about capelin, which is food for cod; and seal, which eats cod? Do they influence cod recovery?
86. Do you think by-catch would affect recovery? If so how?
87. How about climate change? Do you think it will affect fish migration and fish abundance?
88. In terms of priority, what should be the top on the agenda for recovery of Northern Gulf Cod stocks?
89. What management measures have not yet been explored since collapse?
90. What are the key uncertainties and risks involved for fisheries recovery?
91. Are there options for credit within the fishery or other livelihood occupations since the moratoria?
92. In your opinion, what are appropriate coping mechanisms during recovery period or restructuring?
93. What government interventions and measures benefit your organization?
94. What regulations and policy measures have a negative impact on your agency (or organization)?
95. Do you collaborate with other agencies or organizations in the fishing industry?
96. What is your relationship with other stakeholders and organizations?
97. What is the level of power amongst stakeholder groups and organizations in recovery planning?
98. Who is actively involved and who is left out?
99. Do you get any challenges in getting across important inputs or opinions on recovery?
100. What are the current challenges facing your agency or organization?
101. Are there any education and training program available for your members and affiliates?

102. How would fish trade and sustainable certification schemes affect cod recovery prospects?

Section E: Attitudes and stewardship values towards recovery (for all key informants)

103. Stewardship has been identified as a key factor in resource management and recovery efforts, where stakeholders take care of the resource for present and future generations.

a. What does stewardship means to you?
b. In your opinion, what role, might stewardship play in recovery of the northern Gulf cod stocks?
c. What would a well-stewarded fishery look like?
d. What would it take to achieve good stewardship?
e. Who would be the primary stewards?

104. In your opinion, which of the following play an important role in influencing stewardship

a. Education and awareness
b. Income levels
c. Sense of ownership of resource
d. Economic incentives
e. Participation in management
f. All of the above?
g. Other

105. Which of these conservation topics concerns you? Choose all that apply

a. Healthy fish population
b. Critical habitat protection
c. Market factors and globalization

d. Overfishing

e. Sustainable fishing practices

f. By-catch and discards

g. Other____________________ Reasons/comments ____________________

106. What types of incentives in your opinion would promote compliance with regulations?

107. Choose from a scale of **strongly disagree to strongly agree** on the following sets of statements about cod recovery:

Statement	**Strongly Disagree**	**Disagre e**	**Neutr al**	**Agree**	**Strongly agree**	**Comments (if any)**
I am willing to accept any management measures for recovery so long as I am consulted						
I am willing to accept any management measures for recovery so long as I get to participate in the decision-making						
I am willing to accept a moratorium on directed fishing for cod						
I am willing to accept a moratorium on cod by-catch						
I am willing to accept closed areas for nursery, spawning and breeding stocks for cod recovery						
I am willing to accept closed seasons on directed fishing for cod recovery						
A closed and protected area in Bonne Bay (or any major fishing area) is useful for protecting critical habitats and inshore cod stocks						
Some closed areas may threaten other resource users						
I would prefer to consume, harvest or sell another whitefish similar in price and quality to cod						

Section F: Information requirements for recovery (for all key informants)

108. What types of information are necessary for successful future cod industry recovery efforts (check all that apply)? Information on-prompt:

a. Biology of cod fish

b. Capelin and seal abundance

c. Critical habitats

d. Fish migration patterns

e. Environmental change

f. Discards and by-catch

g. Fishing mortality

h. Illegal, unreported and undocumented fishing

i. Local ecological knowledge

j. Fleet size and capacity

h. Labour market & demographics

i. Policy instruments and their effects on behavior

j. Sustainable fishing practices

k. Markets, marketing opportunities & supply chain information

l. Consumer preference and taste

m. Food quality and inspection

n. Marine stewardship certification

o. Ways to improve transportation efficiency and effectiveness

109. In your opinion, is the information currently available adequate for recovery? If not, where, in your opinion, are the most important information gaps?

110. Are these types of information easily accessed by various stakeholders such as fish harvesters? If not, where do you see the greatest challenges/opportunities for improvement?

111. Which of the following agencies have played an important role in providing information essential to recovery? Prompt:

a. Government agencies
b. Fishing industry
c. FFAW
d. Universities
e. Environmental NGOs
f. Community sources
g. International agencies

112. Which could and should play a stronger role in the future?

113. What are the challenges for sharing information and integrating knowledge amongst managers and resource users? Prompt

a. Lack of collaboration
b. Validation and calibration
c. Temporal and spatial scale issues
d. Institutional support
e. Funding and resources.

114. Are enough funds available for fisheries management (stock assessment, monitoring and surveillance) and towards users groups such as FFAW for sentinel fishery?

115. Any suggestions and ideas on how knowledge sharing and integration could be done more effectively to promote recovery?

Section G: Governing mechanisms and policy initiatives for recovery (for all key informants)

116. What policy measures and actions are, in your opinion, key to recovery of the cod stocks on the west coast cod fisheries? Choose all that apply

a. Laws and regulations
b. Economic incentives
c. Participatory approaches
d. Information measures
e. International instrument
f. Voluntary schemes
g. Other ____________Reasons/comments____________________________________

117. What types of institutional and management approaches, in your opinion, are the greatest potential for recovery? Prompt:

a. Top-down central authority
b. Consultative arrangements
c. Co-management
d. Self-governance (e.g. Community management or transferable quotas)

118. In your opinion, what types, if any, of public involvement methods and participatory approaches are valuable for recovery? Choose all that apply

a. Open public meetings
b. Task force teams
c. Regular consultations
d. Partnership arrangements
e. Unsolicited inputs
f. Advisory committees

g. Ad hoc committees

e. Other ___________Reason/comments? ____________________________________

119. What makes recovery policies socially acceptable? Choose all that apply

a. Rules and procedures for all resource users

b. Decentralized policies

c. Absence of special interests

d. Accountability and transparency

e. Freedom of information

f. Other________________

g. Comments/remarks____

120. In the event of a long and unsuccessful recovery, who would lose in the short and long term?

a. Short term ____________________________

b. Long term_____________________________

c. Comments/reasons__________________________________

121. What are the most common types of conflicts evident in current recovery efforts? Choose all that apply

a. Diverse interests

b. Short term benefits and long term cost

c. Equity & social justice

d. Mistrust and unresolved issues

e. Ineffective communication

f. Non compliance

g. Knowledge gaps and uncertainties

h. Other___________

i. Reason/comment ______________________________

122. What are the best ways to deal with these conflicts

123. How would you assess the current decision-making process for recovery? Prompt:

a. Collaborative and broad-based

b. Contains conflict resolution mechanisms

c. Includes trust building approaches

d. Presence of lobbyist and special interest group(s)

e. Too slow and technical

124. What could resource users do differently in recovery efforts?

125. What about community groups and environmental organizations?

126. What could policy makers do differently in recovery efforts?

127. Do you think the policies for recovery from the federal and provincial governments are well interlinked?

128. How could the regional development boards further contribute to community development during recovery transition?

129. Are you satisfied with the overall recovery efforts, if no, what could be done differently?

Appendix II: Interview consent forms

My name is Ahmed Khan; I am a PhD candidate at Memorial University and a member of the Community University Research for Recovery Alliance (CURRA) Project. The CURRA project is funded by the Social Sciences and Humanities Research Council of Canada and its main focus is working with west coast communities to find ways to support recovery of the Northern Gulf fisheries and fishing communities.

As part of the research for my Ph.D., I am interviewing harvesters, processors, scientists, managers, marketers and others. The purpose of these interviews is to help me compare the operation of what researchers are calling the 'cod fish chain' (i.e. movement of cod from the ocean to the plate) as it existed in the 1980s (prior to the collapse of the Northern Gulf cod stock and fishery closure) with the cod fish chain operating today. This research is part of a larger project that uses existing documents, statistical information, scientific research and key informant interviews to help develop a better understanding of potential opportunities and barriers to the recovery of the Northern Gulf cod industry in the near and more distant future. I am particularly interested in knowing about things that might help to promote recovery of the Northern Gulf cod stocks and related fishery in the future, what a strongly recovered industry might look like from the point of view of different stakeholders and insights into potential barriers to recovery along the fish chain identified by stakeholders. These opportunities and barriers might be located at the level of the resource, in the harvesting sector, processing sector, in markets, government policy or elsewhere.

I am contacting you today to see if you would be willing to participate in one of the key informant interviews for my research. Key informants are people like you who are very knowledgeable about some aspect of the Northern Gulf cod fishery pre- and post-collapse. My key informants include harvesters, processors, processing workers, representatives from seafood processing associations, unions, resource scientists and managers, policy makers, and marketing representatives with a long-standing association with the Northern Gulf cod fisheries. The list of people we are calling about these interviews is based on background research I have done on the Northern Gulf cod fishery past and present, as well as suggestions from other participants in the CURRA Project research.

Before asking you if you would be willing to participate, I need to explain more fully what I will be asking you to do if you agree to participate, and any risks or benefits you might experience if you participate. If you agree to participate, the interview will take about 1-2 hours of your time. The schedule will focus on seven main areas: (i) the status and prospects of restored fisheries ecosystems for Northern Gulf cod, (ii) scientific information and management efforts, (iii) socio-economic and livelihood concerns, (iv) organizational decision-making, (v) documenting attitude and stewardship towards recovery, (vi) information needs necessary for recovery, and (vii) governing mechanisms and policy initiatives for recovery. With your permission, I would like to tape the interview to permit me to concentrate on asking the right questions and to ensure that none of the information you provide gets lost. If you agree to be taped, I will send you a copy of the tape and you will be able to decide what happens to the original and the typed summary of the information on the tape at the end of the project.

I think the risks to you of participating in the project are minimal. The risk to you is when your opinion or a particular quote is associated to you or your organization, which is unlikely as all necessary steps will be taken for anonymity and confidentiality through coding and non-use of names or places. The potential benefits to you are limited to the opportunity you will have to influence the findings from this research.There are potential collective benefits associated with documenting knowledge for recovery efforts as well as exploring options for livelihood and coping mechanism. Collective benefits also lie in improving compliance and stewardship opportunities, as well as addressing spatial governance concerns through management initiatives, institutional arrangements and policy reforms when considering options.

You are free to participate or not participate, you may decline to answer any question put to you, and you are under no obligation to explain or justify your decision. You can withdraw from the study at any time. If you consent to the use of your name in reports, publications and presentations, you can indicate what information you would like to be on the record and what information should be treated as off the record. I intend to present preliminary results from this research at a public meetings and community events. This will give people like you an opportunity to comment on the research and to identify any gaps or incorrect information in the report. Should you wish to contact my supervisors for any reason (Ratana Chuenpagdee and Barb Neis); they can be reached by e-mail at ratanac@mun.ca, or bneis@mun.ca or by phone at 737-3157, 737- 7244, respectively. My contact information is as follows, email ahmedk@mun.ca or phone 743 2413.

The information provided in the recorded interview and digital recordings is potentially a very valuable resource for other researchers. If you are willing to have a copy of these archived at the Folklore Archive at Memorial University for use by future researchers for approved research purposes, please indicate this below. Digital recordings and transcripts will be retained by the researchers in a secure location for at least 10 years. Should they choose to have your digital recording deposited at the Folklore Archives, a copy of the master list of names will be deposited with the head archivist who will keep it confidential subject as required the conditions listed below. Please check the option(s) you would prefer below. I hereby authorize:

OPTION 1: _Retention of digital recordings and interview transcripts only by the research team.

OPTION 2: _Placement of tape and transcript in the Folklore Archive, Memorial University.

OPTION 3: __ In addition to the options above, I wish to have a copy of the tape sent to me.

OPTION 4: __Destruction of the tape after completion of the research.

We are very grateful if you would participate and share with us your experience and knowledge about the Northern Gulf cod fisheries in order to explore recovery options. You are aware of the potential risks and benefits associated with your participation in this interview, and you have been given the opportunity to ask questions about and to offer opinions about those risks and benefits. If you are willing to participate please sign and date this form.

I hereby agree to participate in a recorded interview with the researcher named below, subject to the conditions listed below.

Name ________________ Signature____________________ Date ________

Researcher (MUN) Name (print) ___Ahmed Khan______________. Signature_____Date

I would/would not like a copy of the audio recording/text of this interview

If yes, mailing address: ______________________

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethic policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 737-8368.

Appendix III: Ethics approval letter

MEMORIAL UNIVERSITY

Interdisciplinary Committee on
Ethics in Human Research (ICEHR)

Office of Research
St. John's, NL Canada A1C 5S7
Tel: 709 737 8368 Fax: 709 737 4612
www.mun.ca

October 16, 2009

ICEHR No. 2009/10-011-AR

Mr. Ahmed Khan
Department of Geography
Memorial University of Newfoundland

Dear Mr. Khan:

Thank you for your submission to the Interdisciplinary Committee on Ethics in Human Research (ICEHR) entitled *"A fish chain analysis of Northern Gulf cod recovery options in Western Newfoundland (CURRA project: Governance sub-component Case Study 2)"*.

The Committee has reviewed the proposal and appreciates the care and diligence with which you have prepared your application. We agree that the proposed research is valuable and important, without an excessive level of risk to participants. The proposed project is also consistent with the guidelines of the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans* (TCPS). *Full ethics approval* is granted for one year from the date of this letter.

Although approval has been granted, the Committee would like to remind you that Memorial University's statement on *Integrity on Scholarly Research* (http://www.mun.ca/policy/site/policy.php?id=130), *Section 1.3*, which our Board follows, states that primary data (raw data) collected during research involving human subjects must be kept securely and consistent with procedures that ensure confidentiality and privacy for a period of five years from the date of completion of the research except where such access could violate the anonymity of subjects or the confidentiality of the data.

If you intend to make changes during the course of the project which may give rise to ethical concerns, please forward a description of these changes to the ICEHR Co-ordinator, Mrs. Eleanor Butler, at ebutler@mun.ca for the Committee's consideration.

The TCPS requires that you submit an annual status report on your project to ICEHR, should the research carry on beyond *October 2010*. Also, to comply with the TCPS, please notify us upon completion of your project.

We wish you success with your research.

Yours sincerely,

Lawrence F. Felt

Lawrence F. Felt, Ph.D.
Chair, Interdisciplinary Committee on
Ethics in Human Research

LF/bl

cc: Supervisor – Dr. Ratana Chuenpagdee, Department of Geography

Appendix IV: Author agreement (Khan and Neis, 2010)

I declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

I confirm that the manuscript has been read and approved by my co-author. I further confirm that the order of authors listed in the manuscript has been approved by the two of us. Both of us understand that I am the sole contact for the editorial process. I am responsible for communicating on behalf of my co-author about progress, submissions of revisions and final approval of proofs.

Signed on behalf of authors:

Ahmed S. Khan