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adaptive landscape: The case of Southwest Nova Scotia**

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# Household vulnerability and institutional fragility in a socially constructed adaptive landscape: The case of Southwest Nova Scotia

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## Abstract:

Fishing communities and fisheries governance systems are dynamically engaged in a process of social, ecological, and economic change as they respond to double exposure from globalization and climate change (Leichenko and O'Brien, 2008). In this study of the multi-species fishery of Barrington, Nova Scotia, I examine how fish harvesters have responded to warming water temperatures and declining wharf prices. In the summer of 2012, I conducted 31 semi-structured interviews with fish buyers, harvesters, and association leaders with questions focusing on the challenges they faced, and how they responded to these challenges. Using Ostroms diagnostic framework for coding variables, content analysis, and multi-dimensional scaling of the co-occurrences of themes, I found that interview respondents discussed three main processes affecting household vulnerability outcomes. First, due to low social cohesion among harvesters, associations and the government, harvesters favor individual responses to the challenges they face. Second, differential knowledge and capital control during the privatization, marketization, and decline of fishing access rights has increased the dependency on lobster as a sole source of income for many harvesters. As dependence on lobster has increased in the region, the severity of seasonal gluts has increased, exacerbated by a decline in demand for lobster since the economic crisis of 2008 and changing water temperatures. These three processes have contributed to lower incomes for some captains, lower crew employment and crew-shares, and increased emigration from fishing communities. Using McLaughlin and Dietz (2008) concept of socially constructed adaptive landscapes, I situate these processes within the context of the social construction of the tragedy of the commons in Atlantic Canada, in which government policy favored a massive expansion of fishing effort while simultaneously expanding jurisdictional control over all fishing grounds within the 200-mile limit, ultimately leading to the decline of Atlantic Canadian cod stocks. Thus, current levels of dependence on lobsters are the product of the historical structural framing of problems, current political economic structures, changing water temperatures, and the differential agency of harvesters, buyers, and association leaders. I argue that Ostrom (2005) emphasis on biophysical processes, community attributes, and rules-in-use is complementary to McLaughlin and Dietz (2008) conceptualization of structure, agency, and the environment. The results of this research support calls to move beyond the blueprint approaches to fisheries governance, and those that focus on procedural justice in deliberation processes.

## Keywords:

Fisheries, Lobster, Individual Transferable Quota (ITQ), Climate Change, Atlantic Canada, Justice, Collective Choice, Vulnerability, Livelihoods.

# Household vulnerability and institutional fragility in a socially constructed adaptive landscape: The case of Southwest Nova Scotia

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## 1 Introduction

Despite increasing recognition of the failure of panaceas to solve social-ecological dilemmas (e.g. Ostrom, 2007; Davis and Ruddle, 2012; Scott, 1999), policy-as-panacea remains strong. This difficulty to go beyond panaceas has been attributed to the impermeability of disciplinary boundaries which create “tunnel vision” and “disciplinary dogmatism” (Degnbol et al., 2006), a lack of attention to mismatches in spatial and temporal scales (Cumming et al., 2006), and more generally, “frame invariant” approaches to complex problems (Leach et al., 2007; Ostrom, 2007; Scott, 1999). In a special feature on “Going Beyond Panaceas”, Ostrom (2007) suggests a framework to systematically diagnose social-ecological systems. Ostrom has suggested this diagnostic framework as a tool for different disciplines to identify the complex combinations of multiple variables that effect incentives, interactions of various actors, and outcomes within social, economic, and political contexts. Frameworks such as this can further the goal of interdisciplinary bridging, while maintaining enough flexibility to incorporate multiple research agendas, protocols, and methods.

While the diagnostic framework gives direction toward understanding the sustainability of social-ecological systems, we must also under-

stand social ecological systems dynamically, as actors, structures, and environmental variables change over time. In a globalized economy with increasing connections across space and time, households, communities, and regions are increasingly exposed to a mix of opportunities, risks, and uncertainties (Young et al., 2006; Leichenko et al., 2010; Leichenko and O’Brien, 2008; O’Brien and Leichenko, 2000). Climate change and global economic change are interlinked processes that constitute “double exposure”, and produce spatially and temporally heterogeneous outcomes (Leichenko et al., 2010). Leichenko et al. (2010) show how interactions between the financial crisis of 2008 and climate change have changed contextual conditions, responses and feedbacks, and outcomes for rural households in the Central Valley of California. Similarly, this study will show how the interactions between the financial crisis and climate change constitute double exposure for the multi-species fisheries of Southwest Nova Scotia (SWNS), Canada.

In this study, I combine Ostrom’s diagnostic framework with the concept of a socially constructed adaptive landscape (McLaughlin and Dietz, 2008) to understand how changing characteristics of resource users, the governance regime, and the resource system under conditions of double exposure have influenced the interactions and vulnerability outcomes for

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fishing households and communities. Additionally, I show that household-scale vulnerability can create fragility at larger system-level scales. The case of SWNS provides an interesting case where harvesters face a curse of abundance rather than scarcity, and where climate change has altered the spatio-temporal patterns of lobsters, requiring harvesting groups to adapt. Additionally, this curse of abundance has come at the same time as the economic crisis, resulting in a significant drop in wharf prices. I will demonstrate the interactions of three processes in the SWNS fishing industry working at different scales. First, the history of distrust among harvesters, buyers, and government officials due to distrust and a lack of procedural justice has resulted in a rigidified decision-making process that lacks the capacity to respond to double exposure. Second, neoliberal policies and informal property rights institutions have been used by powerful individuals and groups to concentrate control over fisheries access, resulting in unequal access to fisheries that could supplement the incomes of fishing households. Third, water temperatures and trophic changes, combined with differences in harvesting strategies and technologies, have resulted in higher overall landings, but not necessarily higher incomes for captains and crewmembers. Before detailing the results of ethnographic research in a fishing municipality in SWNS, I will outline the theoretical framework on which this research is founded.

## 2 Theoretical Framework

In the context of double exposure scholars have attempted to understand the social, ecological, political and institutional characteristics of social-ecological systems that make them vulnerable, robust, or resilient (e.g., Eakin and Luers, 2006; Anderies et al., 2004; Walker et al., 2009). While all of these conceptions are helpful to understanding SES', here I focus on vulnerability. A group or unit of concern (fishing

households, communities, fisheries) are said to be vulnerable if they are at risk for particular adverse outcomes from a variety of stressors, and if there are other factors that reduce their capacity to respond to, or adapt to these stressors. According to (Clark et al., 2000), vulnerability consists of three components: 1) exposure, or the degree to which a group is exposed to a stressor, 2) sensitivity, or the degree to which a group is sensitive to this exposure, and 3), resilience, or the ability to resist, recover, or adapt to the stressors they are exposed to. Thus, in the context of the current research, double exposure constitutes exposure to the financial crisis of 2008, a global process locally experienced as low demand for lobster, and the ecological consequences of climate change. All fishers in the study site are lobster harvesters, and thus, all are doubly exposed to some extent. However, the main research objective in this study is to understand the sensitivity of harvesters and their ability to respond to low wharf prices and ecological change.

Vulnerability research brings together the processes by which socio-political structures, heterogeneous human agencies, and environmental processes lead to variable outcomes for social groups or subgroups (McLaughlin and Dietz, 2008). The degree to which a social group or subgroup is exposed depends on the spatial and temporal distribution and magnitude of biophysical stressors. Humans, however, are active agents attempting to cope or to alter the biophysical environment (Corbett, 1988; Adger, 1996). Human agents also make use of political and economic structures to respond to change, but heterogeneity arises due to unequal political and economic power, which often increases vulnerability for some groups (Pelling, 2001; Wisner, 2003). The differential characteristics of vulnerability is also the product of the different socio-cultural framings of risk and exposure, often influenced by socially constructed categories such as gender, class, and race (Tierney, 1999; Enarson, 2002).

McLaughlin and Dietz (2008) have framed this interaction between structure, agency, and the environment as a socially constructed adaptive landscape that actors adapt to, reshape by legitimizing or delegitimizing specific social structures, and partition by constructing or deconstructing social boundaries. Given these social, political, and economic interactions on this landscape, some social forms are “reproduced” (Burns and Dietz, 1992) and persist while those that are most vulnerable do not (McLaughlin, 2011).

Based on previous research on common pool resources (CPRs), and in response to discussions on important characteristics of CPRs that lead to sustainable outcomes (e.g., Agrawal, 2001, 2005; Mansfield, 2004), Ostrom’s 2007 framework provides a list of structural, environmental, and resource user attributes that are relevant to diagnosing the sustainability of a social-ecological system. This framework, however, is best understood along with the Institutional Analysis and Development (IAD) framework, which conceptualizes the dynamic process by which communities attributes, biophysical conditions, and rules influence the interactions of actors, leading to outcomes, evaluations, and a feedback by which actors modify the system for desirable outcomes (according to evaluative criteria) (see Ostrom, 2005; Ostrom et al., 1994). The concept of robustness has been used along with the IAD and diagnostic frameworks to refer to human construction and modification of the various components of an SES to respond to perturbations, and maintain quantitative system performance measures, such as economic growth, economic productivity, or environmental quality (Anderies et al., 2004; Janssen et al., 2007).

Given the inclusion of structure, agency and environment in these frameworks, it is apparent that the processes by which vulnerable or robust conditions are produced is due to relations between multiple scales and levels (Adger et al., 2008). Here I use levels to refer to hier-

archically arranged jurisdictions or territories, such as state, province, region, or fishing port, (Poteete, 2012), and scale to refer to the spatial or temporal “resolution” used to study a phenomenon (Cash et al., 2006) or chosen by social actors (Neumann, 2009). While robustness literature tends to focus on the dynamics and properties at the system-level leading to fragility, vulnerability research focuses on the characteristics of households (Anderies and Janssen, 2011). Thus, I use the terms vulnerability to refer to households, and fragility to refer to the system-level. Structure, agency, and the environment interact at multiple scales, and actors at multiple levels negotiate access to resources with implications for higher and lower levels. Ultimately, a process that may be adaptive at the household level, may scale-up to create fragilities at the level of a fishery, or fishing region. Additionally, there is nothing necessarily “inherent about scale” Brown and Purcell (2005), that is, there are no inherent conditions at a particular scale that make the “local” more effective at managing a resource than larger regions. Instead, the effectiveness of management or governance regimes depend on the ways that institutions match with the relevant scales of knowledge and scientific understanding (Cash et al., 2006). In this study, I consider the interactions occurring at and among the levels of the household, associations, the lobster fishing district, and Fisheries and Oceans Canada (DFO), a federal government organization for managing the fisheries of Canada.

The above discussion leads to a conception of vulnerability and robustness that includes the multi-level and multi-scale interactions between socio-political structures, human actors, and the biophysical environment. Scholars have also pointed out, that vulnerability research must pay attention to power relations, the distribution of access to resources, technological change, and the degree to which a system can be said to follow a norm of justice, (McLaughlin and Dietz, 2008; Eakin, 2005;

Wisner, 2003; Downing et al., 1996; Kelly and Adger, 2000). In this research, I consider the SWNS multi-species fisheries as a socially constructed adaptive landscape under double exposure, and analyze household level responses to wharf prices, the decision-making process, and sociopolitical structures that they face, and the implications these responses have at the scale of the wharf-scale and the region. The resulting discussion highlights the importance of justice, equity, agency, and the uneven economic and political power relations that lead to heterogeneous outcomes for households.

## 2.1 Vulnerability in Fisheries

The Food and Agricultural Organization (2008) estimates that 43.5 million people directly depend on capture fisheries for their livelihoods, with many million more involved in indirect employment along the commodity chain. But while demand for protein from fish protein continues to increase in developing countries as incomes increase (Food and Agricultural Organization, 2008), the majority of fisheries studied to date are either overexploited, being rebuilt, or at their maximum level of exploitation (Worm et al., 2009). This has important implications for food security, and for the vulnerability of the livelihoods of those who are dependent on overexploited or fully exploited fisheries. Further, climate change is projected to have significant impacts on marine systems, altering nutrient cycling, water temperatures, ocean pH and chemistry, and the frequency and severity of extreme events (Brander, 2007; Worldfish Centre, 2007).

Johnson and Welch (2009) developed a vulnerability framework to assess the exposure, sensitivity, and adaptive capacity of marine fisheries. As climate change progresses, they argue that fisheries with high exposure and sensitivity to changing biophysical conditions, with high rates of exploitation pressures, and limited adaptive capacity due to resource dependence and weak economy are most at risk.

Thus, they suggest that western and central African nations are the most vulnerable due to high dependence, high levels of exposure, and a low economic and social capacity to respond (FAO, 2007; Johnson and Welch, 2009). This broad-scale vulnerability research can be useful for setting priorities for the management of and capacity building for the most vulnerable fisheries around the world. They do not, however, address specific processes occurring socially among harvesters, buyers, and managers that lead to high sensitivity and low resilience. In the following discussion, I provide case-study research to outline these social, political, and economic processes, and the outcomes for the fishery of SWNS. This study can be used by broad-scale studies of fisheries vulnerability, and by those who focus on the potential and actual consequences of policy instruments and decision-making processes. While it may not be among the extremes of vulnerability, the processes by which vulnerability is produced, and the outcomes for resource users is relevant to fisheries experiencing similar struggles.

## 3 Study Area

### 3.1 Barrington, Nova Scotia

The Atlantic Canadian lobster fishery is Canada's most valuable seafood with an annual export value ranging from \$800 million to \$1 billion, and recent catches averaging between 110 to 120 million pounds across the Maritimes. This fishery is also an important source of employment, supporting 10,000 license-holders as well as additional crew, buyers, processors, boat builders and retailers.

I focused my research in Barrington Municipality (hereafter referred to as Barrington), Nova Scotia, often referred to as the "lobster capital of Canada". Barrington municipality includes a large number of communities situated around fishing wharves, including Woods Harbor (Nickerson, 2012), Cape Sable Island, Port

La Tour, and Baccaro (Davis, 1984a). Southwest Nova Scotia is also used as a generalization for the region.

Similar to many towns in the region with economies based on the fishing industry, Barrington has been in a state of decline since the mid 1990s, when the DFO began to set strict regulations on the groundfisheries (i.e., cod, haddock, pollock, hake) after the collapse of codfish stocks on the Grand Banks of Newfoundland. As a result, Barrington has experienced decreasing population, increasing unemployment, high dependence on unemployment insurance, and lower median incomes than the average for Canada and for Halifax, the nearest urban center, although costs of living are also significantly lower. Fortunately for many maritime fishing towns, the decline of the ground fishery coincided with massive increases in lobster landings (from around 33 million pounds in 1975 to 125 million pounds in 2010), allowing many in the ground fishing industry to re-focus on lobster. As landings increased, however, the demand for lobsters has not kept pace. This has resulted in decreased prices concurrent with increasing costs of bait and fuel due to global fuel demand and lower regional and global supply of bait-fish (e.g., herring, mackerel).

### 3.2 Description of Management System

The lobster fishery is currently managed by the DFO under advice from regional management boards. The fishery is spatially divided into 41 Lobster Fishing Areas (LFAs) or districts, each with their own management and advisory boards, local port reps, and different fishing seasons. Barrington is located on the border of LFA 34 and 33, with Port La Tour and Baccaro in LFA 33, and Cape Sable Island and Woods Harbor in LFA 34. The details of the regulations vary by LFA, but all LFAs have a minimum size requirement for carapace length (3.25" in LFA 34 and 33), seasons (last monday of November until May 31st in LFA 34 and 33), v-notching, and trap limits (375 in LFA 34, 250 in LFA 33),

requirements for escape hatches for undersized lobsters, and the requirement that all female egg bearing lobsters must be returned to sea. There are additional regulations specifying the types of technologies used for fishing, including rope, lobster pots. Finally, all LFAs have limited entry licensing. LFA 34 is limited to 985 licensed fishing vessels, while LFA 33 is limited to 720. Vessel size is limited to a 45' length with an allowance for a 5' extension with no limits on width.

## 4 Methods

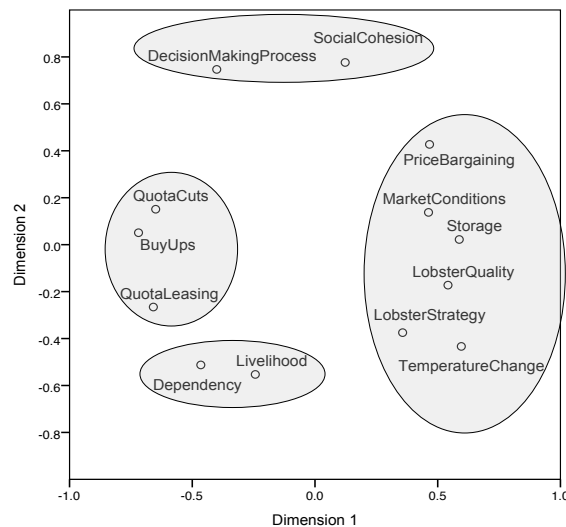
In the summer of 2012, I conducted participant observation, semi-structured interviews and surveys. I used a combination of snowball sampling with random sampling. First, key informants helped me develop a list of potential respondents. I selected respondents randomly from this list. I then added potential respondents to the list as survey and interview respondents recommended knowledgeable people, or any other person to talk to that might have a different perspective. This list was used for semi-structured interviewing, and a face-to-face surveys. Overall, I interviewed two retired harvesters, two lobster association leaders, two groundfish associations leaders, 16 active harvesters, five lobster buyers, and two government officials or representatives. For the purpose of anonymity, I refer to association leaders, officials and representatives as "local experts", and use pseudonyms for all individuals. Interviews lasted between thirty minutes and two hours. While questions were varied for each type of respondent, all respondents received four similar types of questions (See Appendix A).

I coded transcriptions of interviews, field notes, and additional comments to surveys using Ostrom's (2007) second-tier variables, and coded third tier variables inductively. My unit of analysis was a paragraph of texts, usually corresponding to an answer to a ques-



tion. In cases where respondents brought up multiple subjects, I used transitioning statements to break up the transcript into paragraphs. I include the 13 most discussed themes based on number of occurrences in this analysis. Using MaxQDA, I generated a matrix of co-occurrence of themes corrected for the number of times a theme was mentioned by dividing the number of co-occurrences by the product of the number of occurrences of the two themes. This corrects for the probability that frequently mentioned themes will have more co-occurrences with all themes. I analyzed the matrix of co-occurrence using multidimensional scaling (UCInet). After I determined main themes, I used Wilcoxon tests to test for differences in the frequency of themes discussed by buyers and harvesters during interviews only (local experts were not included in this test due to low N).

## 5 Results and Discussion



**Figure 1:** Multidimensional Scaling of themes from semi-structured interviews, surveys, and field notes, coded according to Ostrom (2007).

Multidimensional scaling of the 13 most frequently discussed themes distinguishes four main clusters. These themes are illustrated in figure 1 in a two dimensional plot with a stress

of 0.206, slightly above the 1% left-hand tail cut-off value for 13 objects in two dimensions (see Sturrock and Rocha, 2000). These four clusters of themes will be discussed below using exemplary quotes.

### 5.1 Decision-Making And Social Cohesion

Themes of social cohesion and the decision-making processes occurred 126 and 99 times respectively. Among harvesters, associations, and processors, there was little trust in the DFO, and the decision-making process was deemed unfair. These stem from key procedural issues in the fishery (see Leventhal, 1980). The first missing element of procedural justice in the decision-making process is consistency:

...we used to have to comply to owner-operator, it was one boat one license, one license holder, then this lady came in Yarmouth and she said, "No, now you are allowed to stack a license...", and so, behind closed doors, this was negotiated with companies...and then...she was transferred, so who do you complain with? (Jake, harvester)

This sets up uncertain conditions making it difficult for harvesters and new entrants to plan, invest in fishing and gear, or retire from the fishery. Also, given the frequent turnover of DFO officials, it is difficult to make long-term decisions.

Second, the DFO is probably most criticized for the accuracy of scientific information used in quota determination and cuts, most notably for determining groundfish quota allocations. Harvesters have criticized the DFO's sampling techniques used to estimate biomass, and ultimately, quota allocations. A mobile gear vessel (i.e., bottom trawler) is more conducive to the scientific methods of random sampling with transects. According to scientific logic, randomly placed transects done over time should

estimate overall average abundance for a given fishing zone. To harvesters, this practice underestimates abundance for three reasons. First, some transects are located in areas that harvesters have known to be of low productivity. Second, as climate change has affected currents and water temperatures, the high productivity areas for fishing have changed. Finally, fixed gear longliners often argue that baited hooks can demonstrate better productivity, because they catch fish when they are biting. Harvesters and managers invoke different and often competing ways of knowing the oceans. These ways of knowing frequently clash at meetings.

Third, if a decision is made, industry is unable to modify or reverse decisions quickly enough. According to Wyatt, a local expert, "If the fishermen makes a decision and a regulation is put in place, in a years time, he sees it's no good, he will change it. DFO puts it in place..., you might live a lifetime trying to get it changed, to a lot of detriment to your industry."

The other most common procedural problem with decision-making process is the inability of industry to voice their concerns in a way that those concerns are recognized, and accounted for:

These management boards are only in an advisory capacity. So they can make recommendations to Ottawa, and Ottawa will basically dictate what the policies are. To me, there has to be a more direct involvement with these sets of policies, almost on a regional basis, it's very, you have to understand the industry right. (Logan, local expert)

This lack of bottom-up decision-making leads to dissatisfaction, and low participation in advisory processes. In the perception of harvesters, participation does not only lead to frustration and a waste of time, it can also serve to legitimize the DFO decisions they oppose. Aaron

(local expert) recounts, "One of our friends was on [a lobster management board] for years, and DFO said 'Well you fellas passed this.' And he said, 'No, no, we didn't pass it. This is what you told us and we had to pick one or the other. It ain't what we wanted at all.'"

Beyond the above mentioned procedural problems, the decision-making process is also complicated by difficulties in communication between scientists and managers, and the industry. While harvesters have extensive knowledge regarding the exploitation of a heterogeneous and seasonally variable resource, some have trouble understanding the potential consequences of regulatory changes:

You know what fishermen are like....[T]hey know what they are doing out in the boat, but when it comes to conversation with, take lawyers or government people...you just can't comprehend what they are trying to tell you, and they can make things sound good that aren't good. (Brody, harvester)

These decision-making processes would be more consistent, inclusive of local ecological knowledge, responsive, accountable, and understandable with strong bottom-up representation through associations and other forms of organization. To respond to low prices and high catches, and the perceived livelihood threat posed by government intervention, harvesters frequently talked about the need to "stick together," or to "get together and talk about the good of the fishery as a whole, not with personal interest, and take those ideas to the DFO, and tell them this is what we're going to do, not, "will you let us do this?" (Aaron). Marcus, a local expert, suggested that "if fishermen do not get organized, the government will step in and do something."

It is important to note that the frequent call for cohesion may reflect the time of my research, which began one month after harvesters went on strike. While some pointed to

the way that people united during this strike, others pointed out that “people were fighting against each other instead of standing up for each other” (Jackson). These fights arose as some harvesters attempted to go fishing while others were on strike. At meetings in Barrington for LFA 34 and 33, much of the debate over the social cohesion during the strike centered on the variable ability of harvesters to miss days fishing. According to Brody (harvester), there is “[a] lot of difference when you got a big debt hanging over your head, and it affects the way you think too. But like I say, if we could unite as one I think we could be way better, but it’s a very hard thing to do.”

It may be easy to assume that SWNS is homogeneous, without divisions based on race, religion, or class that hinder the potential for collective action. Some communities are mostly Acadian french, some are of British Loyalist descent, and others are aboriginal M’ikmaq. But while these community ties bind people, differences in scale of fishing operation, fishing technologies and type, and geography split people apart. When combined with a strong culture of individualism (Apostle and Barrett, 1992), these differences make it difficult for harvesters to stick together. Despite facing a common problem, meetings to deal with these problems often go bad because “everybody’s got their own opinion and it just mainly gets into an uproar and a fight cause everybody’s got a different opinion what suits them” (Lucas, harvester). In addition, according to some harvesters, social cohesion is further hindered by decreasing social interaction, and a higher prevalence of competitive “cut-throat” attitudes. For example, many harvesters said that people used to help each other haul their boats up for repairs and cleaning. According to Landon (harvester), “people would come out of nowhere to help, as if they were coming from the bushes. Today, they might try to knock your boat over to smash it in two.” Mason (harvester) suggests that “... there’s no helping one another out no

more. There’s no sense of being a fishermen. People aren’t proud to say they are fishermen and we’re losing our culture.” To others, the cut-throat attitude is also an important part of the maritime fishermen’s culture.

Fishing has always been, I’m trying to outsmart you, I’m trying to get the best price, I’m trying to get there first, I’m trying to catch the most, and it’s almost like when this challenge comes along, we’re all against it. We all yell and hoot...and then we start thinking about it, and the more we think, some of us will start splitting off and saying, “I can survive that challenge, but can he?”.... Can I hang in there and survive another year and then maybe I’ll get more. (Easton, harvester)

Nevertheless many instances of fishing communities pulling together to help a troubled harvester suggest that there still is capacity for social cohesion. For example, in December 2010, many harvesters experienced significant damage to their lobstering gear due to a storm. When this happened, community members pulled together to collect pots to give or lend to affected harvesters. To some, this difference in helping each other out is related to the changing self-sufficiencies of people. Today, people don’t need others to haul their boats ashore (as described in Davis, 1984b).

## 5.2 Ownership and Control of Fisheries

The second cluster of themes consisted of quota cuts (85), license and quota buy-ups (76), and quota leasing (77). The nature of a harvester’s ownership status of lobster licenses, and quotas will determine the fixed costs for fishing, and the share of landed value they receive. These variations in ownership types and levels plays a role in the different situations harvesters face.

According to some, the process of buying up quota began even before quota was

introduced. A processing company for example, was described as having an “inside scoop”, making some “smart purchases” to secure quota. According to Jeremy, a lobster and groundfish harvester these individuals who bought up quota “only used the cards...the government give him to play, that’s all. But the little fella, for a quick fix, was selling thinking it was the best way out, right?” As big fella bought up the little fella, quotas for swordfish, halibut, cod, haddock, and other species have become concentrated. The estimates of the extent to which processors own quota varies significantly among harvesters due to the difficulty of gaining access to reliable information. The groundfishery, is a multi-species fishery, and thus, an agent who controls key species can control access to other species. Codfish quotas are at such a low level, that they are considered a by-catch. One harvester suggested that the ideal ratio of haddock to cod quota would be around 4:1, but as the codfish quota decreases to around 6:1 it becomes difficult to catch enough haddock with longline without over-running the cod quotas. Those processors who have secured quota benefit by leasing out quota, and by buying and selling the fish caught from the quota they lease out. While harvesters do not place blame on processors for buying quota up, many harvesters argue that it is not ethically right “that a man should own fish and sit at home” (Aaron, local expert).

This concentration of quota has been exacerbated by quota cuts. Given the perception of an imminent collapse of codfish in the region, the DFO took action to conserve the resource by cutting quota to all harvesters. From 2000 to 2011, the total allowable catch (TAC) for cod in the fixed-gear fishery has been reduced from 3309 to 938 metric tons in 4X, and 858 to 421 in 5Z, corresponding to inshore grounds and George’s Bank respectively. As quotas decreased, those with small initial allocations began to sell what little they had left to other companies or individuals. Given that quotas have

continued to decline, however, it is likely that this has not proven to be a profitable investment. The DFO (2009) report on Cod stocks in 4X and 5Y (inshore Scotian Shelf) reported that though the TAC was reduced in 2000 to rebuild stocks, a high rate of unexplained mortality remains. Thus, the 2009 report recommended further cuts of the cod TAC. The report suggests that this unexplained mortality may be due to high predation rates from seals, as well as discards and unreported landings. Both of these sources of mortality have been suggested by harvesters.

In the codfishery, the quota and fish pricing system incentivizes high-grading and discarding, locally referred to as “shacking” fish. For example, the price of landed cod varies according to the size of fish caught. January 2010 prices ranged from \$0.75 for large to \$0.35 for small codfish. Assuming a vessel has a quota for 10,000 pounds of codfish, this amounts to a difference in landed value of \$4000. Pat (local expert) suggests that the incentive to discard is even more pronounced when the incomes from lobster fishing are low.

..my theory would be high grading would be worse when you have a bad season in the lobster industry... When the lobster industry was booming. I’ll say five years ago, the guys would come in the office where I was located and they would say, Pat, sell my fish, and I’d say, “So what do you want for it?” “Ah, doesn’t matter, long as I get enough to pay you your dues and I get a little money tucked aside for dear hunting.” They didn’t care because they were doing so fantastic on the water for lobstering... they were happy. Now it’s not the same. “What’s the most you think I can get?” And that is, it’s economics. One industry affects the other, absolutely.

Wyatt recounted a meeting in which it was suggested that all groundfish be bought at the wharf with one price. At these meeting, Wyatt stated that fishermen were “stomping against that”, but sees now the potential of changing the price structure to incentivize harvesters to land all of the fish that are caught.

With such drastic declines in quotas, the majority of harvesters that continue to fish in the summer lease quota from dealers, processors, or retired harvesters. Ex-vessel prices for fish and quota leasing prices are governed by different conditions of supply and demand working at different scales, and thus, it likely that the margins between ex-vessel and quota leasing prices vary. One harvester estimated lease prices that amounted to as much as 80% of ex-vessel prices in the halibut fishery, a number that closely approximates those reported in Pinkerton and Edwards (2009). As was suggested above, quota lease prices may be higher when incomes from the lobster fishery decrease, but quota leasee’s will also be more willing to pay more for quota. According to Jeremy, “[y]ou want to know why they go? Cause they’re grasping straws, trying to hang on, a little is better than nothing right?” When margins between lease price and ex-vessel price are small, the risk of returning to port with a negative balance for a fishing trip are higher.

### 5.2.1 Buy-Ups in the Lobster Fishery

Many harvesters fear that the lobster industry will eventually succumb to the same process of consolidation in the quota fisheries. This consolidation depends on the future of owner-operator and fleet separation policies. Owner-operator policy states that a license owner must operate the licensed vessel, while fleet separation states that the harvesting fleet must not be controlled or owned by shore-based facilities. These policies are in place to “maintain an independent and economically viable inshore fleet,...ensure that the benefits of fishing licenses flow to the fish harvester and the

coastal community, and assist fish harvesters to retain control of their fishing enterprises” (Department of Fisheries and Oceans, 2010). These policies where an attempt to avoid a return to the truck system, whereby harvesters were tied by debts and sale of daily catches to one buyer holding a local monopoly to supplies, and a monopsony as fish buyer (Davis, 1975; Innis et al., 1940).

Individuals, processors and fish buyers have been able to circumvent owner-operator policy through contractual agreements. For example, in a trust agreement or controlling agreement, a company or individual may agree to pay a retiring harvester who wishes to sell his license. The retiring harvester will then transfer that license to an eligible fisherman in a contractual agreement with the company. The new entrant, then, is bound to the obligations set out in the contract. In some cases, harvesters are obligated to give a share of their landed value to the company or individual. For example, Jacob, a harvester tied to a lobster buyer in a trust agreement, pays 47% of his landed value to the owner, fishing expenses are then subtracted, and the remainder is split equally among captain and crew. In this arrangement, the captain does not own boat, gear, or license. In other situations, where a captain may have a boat and gear but need a license, some harvesters estimated the share to be approximately 10 to 15%.

Jacob was not particularly distressed about this arrangement. With no large stake in the fishery, he feels that he “...can walk away anytime I like.” Another harvester reported that engaging in a trust agreement saved him from losing his boat, and added that the owner of the trust agreement, “used me pretty good. Without it I would have been out west.” Nevertheless, Jacob, harvesters, and local experts worry about the potential for consolidation of lobster licenses by an individual or agency.

The bigger companies, the ones that own all these groundfish quo-

tas will buy up the lobster licenses also, because they got the overhead, they got the money and then they'll just get someone else. They'll never go aboard the vessel, but they want to just take over, I mean it's just. It's sad... (Chase, local expert)

Andrew (harvester) suggests that companies have taken the current economic problems harvesters face to further consolidate their control

I just looked into it recently. In Shelburne and Yarmouth county, there are 25 boats in arrears with the loan board that can't pay their interest. There are 30 something that are just paying interest, or having interest paid by family members or corporations. [A private agency] is buying up boats in arrears. Fifty percent of Yarmouth boats are corporate owned.

In addition to the take-over effect, Joel and Pat, lobster buyers, argue that "landlocked businesspeople who buy and stack licenses, and lease them out through trust agreements also act to distort the costs of fishing upwards." Dale, a retired crew member, provided the example of a captain engaged in a trust agreement who had "paid for his license twice." From the buyers perspective, a trust agreement may drive wharf prices up, but it may also drive down the price for a harvester, because "if he owned the rig, he'd have more freedom to, you know, sell his lobsters where he wants. He's got no choice, he's got to sell to the buyer" (Brody, harvester).

Additionally, it is well known in the industry that control of licenses can amount to other forms of control. For example, Pat suggests that control of lobster licenses allows captains and processors to have greater control over labor.

Well the crews are out there for free because there's no way they can

get anything from it...If they didn't catch any fish, well they can't pay, and the crews have to stay on, because, say that dragger owns 7 lobster licenses. That crew does lobster and fishing, so even if you do rotten fishing, unless you don't want to lose your lobster site, you're gonna stay on that boat. That's corporate things.

### **5.3 Economic and Ecological Change, and the Price of Lobsters**

Respondents described a complex web of effort, storage, and exchange that links a harvester in Barrington to dinner plates predominately in the United States, China, and Europe. This process exhibits a seasonal pattern that harvesters and buyers knowingly exploit. At the beginning of the season, catches are high, and thus, buyers often open at a lower price. At this time, harvesters store a large proportion of their catch in lobster cars; semi-submerged wood and wire cages. With cold fall and winter temperatures, lobsters enter a dormant state and can be kept alive with minimal effects on quality. Winter weather often limits fishing effort, as storms and rough seas are more prevalent, and cold temperatures limit lobster activity. Buyers store lobsters in tankhouses with refrigerated pools of recirculated seawater. Demand generally increases through Christmas and continues to rise through February (especially during Valentines Day). As a result of this seasonality, the industry can often expect to get double the wharf price that they receive during the opening of the season. Economic, social, and ecological changes increase the uncertainty of the benefits to engaging in the above practices. These uncertainties can be attributed to storage (76), extra-local market conditions (64), water temperature changes (28), lobster quality (82), lobster harvesting strategies (119), and price bargaining(77).

Previous models have effectively explained

the variance in wharf price for lobsters using data on the US-Canada currency exchange rate, overall lobster landings, the GDP of the United States, and the extent to which lobster landings are being processed by Canadian processing plants (Holland, 2011; Fisheries and Oceans Statistical Services, 2007). Thus, given the poor performance of the US currency in relation to the Canadian dollar, and poor economic conditions the United States since the economic crisis of 2008, it is reasonable to expect a decline in demand for lobsters. Additionally, increased landings in the United States and Canada has increased the magnitude of gluts in the beginning of the season, and the extent to which lobsters are sent to processing plants. Jack, a local buyer describes the economic conditions that led to low prices in the spring of 2012:

The Americans start dropping their price because the lower they can get them from us, the more profit they can make from there. They more or less had us. The weather was starting to get better in March, we still had product, our boats still had their product the first week of March, and it was getting scary. I mean [the fishermen] wanted to sell. They were in every day "can you sell my lobsters, can you move the lobsters?" So we sold them and give them the same as what we got for them, and ours was still in storage...That's why we had to start selling them to the processors because the quality was starting to go down, time was going, and the fishermen we're starting to put their gear out for the spring. We were caught in a no-win situation.

With increased landings in the beginning of the season and decreased demand, buyers could not sell their product to the live market quickly enough. As time passes, lobsters stored in tankhouses and lobster cars lose quality due to

"shrinkage" (loss of meat-mass of lobsters), and with the threat of lobsters dying, buyers reportedly sold their lobsters to processors at a loss.

While many fishers do not attribute water temperature changes to climate change, 97% of surveyed harvesters believed that the water temperatures have gotten warmer since they started fishing. In the year 2012, both fishers and scientists have reported anomalous water conditions. For fishers, changing water temperatures affect the abundance and the quality of lobsters, as well as lobster harvesting strategies. Warmer water temperatures increase the metabolism of lobsters, and this may partially explain increases in lobster abundance. Water temperatures also influence the patterns of reproduction and migration of lobsters. Male lobsters prefer habitats where water is warmer, up to 19°C, while females must balance a tradeoff between warm waters which promote growth, and colder waters (below 8°C) which promote ovarian development (Chang et al., 2010). In the spring, lobsters migrate to shallower and warmer inshore waters for molting and mating, and then migrate back to deeper and more stable offshore waters in the fall as surface temperature decrease (Chen et al., 2006). Additionally, with higher metabolic rates and growth rates, it is expected that lobsters may molt more often and at different times. Many fishers also suggested that large quantities of lobsters may be competing more for food, and thus, taking longer to harden and fill their shells with meat. While the ecological interactions that have led to these changing spatiotemporal patterns are not well studied. What is clear, however, is that warmer waters increase the risks of storing lobsters in lobster cars and the costs of storing lobsters in refrigerated tankhouses.

The abundance and quality of lobsters is also the product of harvesting strategies. These strategies are described by Jake, a harvester.

...it used to be an inshore fishery...I'm talking about a guy that goes out at 6:00am, he's back from

3:00 to 6:00 pm. The offshore boats might be gone for two days, three days, and the guy that fishes inside, the bottom is better, lobster is healthier the yield is good. That guy's catch, let's say he catches 30,000 pounds at \$5 a pound is a 150,000. The guy that's put the effort in it that goes deeper... everybody knows the deeper you go the less the quality is, if he catches 70,000 pounds at the same price... who's making the bucks? So we're forcing the industry to go... that's why people are making bigger boats, bigger to follow the Jones or to catch more dollars...

The lobster fishery has a contrasting incentive structure to the groundfishery, with no incentive to focus catches on high quality. In the lobster industry, this incentive structure would not increase lobster mortality because the majority of lobsters caught in traps can be returned to sea and live, while most groundfish species cannot. Thus, harvesters are motivated to fish for quantity, especially when prices are low. For example, Ethan states that "you're really forcing it to try to sustain that income right? I mean, we're forcing a lot harder in the wintertime, fishing harder to try to make up for the downfall in price." While some harvesters stated that they fished harder or more aggressively when prices were low, others used cost reducing strategies, such as "slack[ing] back on the gas pedal", letting lobster traps soak for two or three days instead of one to lower the cost per pound caught, or to seek out cheaper sources of bait.

Warmer water temperatures have also incentivized catching for volume. For example, according to Easton, "a lot of them managed because of the good weather, they fished all through the winters so their catch was up." In Davis (1984b), all harvesters in Port Lameron landed their traps in late January un-

til the weather improved and lobsters started to "crawl". Today, lobsters were reported to be more active throughout the winter due to warmer waters and more stable water temperatures offshore.

Taken together, market conditions, storage, lobster quality, and lobstering strategies have resulted in lower demand, increasing risks to storage, more unpredictable lobster quality, and higher catches, and thus, lower ex-vessel prices. Besides the individualized response to these challenges, harvesters have resorted to bargaining for better prices through strikes. In the May 2012 strike mentioned above, some of the 1688 harvesters in LFA 33 and 34 refused to fish if prices dropped below \$5 per pound. Harvesters were divided on the effectiveness of this tactic. For example, on the one hand Liam stated that "[i]t's not like...we won't catch our lobsters this week because the price is down, when the lobsters are crawling and the water's warm, you gotta catch 'em". Alternatively, Noah suggested that "you're not going to miss out because you'll catch them in the spring."

Harvester collective bargaining strategies have been proposed to correct imbalances in the port market system, in which harvesters have little choice but to sell a deteriorating resource to local buyers, and in which local buyers are, in turn, given little choice from those higher up in the lobster market chain. This process was well documented in Steinberg (1984) and Apostle et al. (1992). Local buyers, however, often suggested that the strike tactic has been too confrontational against them. For example, Aiden stated that "these fishermen think that the dealers get together and say let's rip off the fishermen. It's not that way. I was losing money. All of my fishermen have lobster cars. The big cookers [processors] set the price. I've been taking a lot of abuse." In an interview involving two buyers, Joel and Pat, both also suggested the upward pressure on prices in some regions. For example, "Cape [Sable] Island is a hornet's nest. Buyers are fighting over boats,



and this spills over off the island.” The majority of this competition, however, was reported at the local or port market level.

#### 5.4 Livelihood Outcomes for Fishers

Figure 1 shows a cluster for livelihoods and dependency, which also co-occurred frequently with the cluster of ownership and control discussed above. The extent to which harvesters depend on lobster as a sole source of income (82), and livelihood outcomes (92) are a function of quota ownership and cuts, the extent to which a harvester owns their operation, and the lease prices they pay.

Davis (1984b) reported a multi-species fishery in Port Lameron, with harvesters fishing for cod, haddock, hake, pollock, herring, mackerel, and lobster. Due to declines in all fisheries except the lobster fishery, dependence on lobster has increased significantly. A retailer in Barrington pointed out that this creates a lot of tension as lobstering season begins. “There is a lot riding on the first haul of the year...Fishermen will have their new furnaces and their Christmas gifts on layaway, and they aren’t ready to pay for it until their first haul.” In some households, spouses have taken on jobs to supplement household incomes. Additionally, harvesters more often spend the summers repairing and building pots and lobster cars to reduce the costs of fishing. Whereas in a multi-species context, harvesters would “spread things out all over the year, they got to depend on that one season to make their living and there’s so much pressure being put on it” (Brody, harvester).

For some, higher lobster catches have made up for lower prices, and incomes have remained stable. The variability of livelihood outcomes is summarized by Chase (local expert):

Every family has a different challenge... it’s hard because the people that have been in the fishery for years... basically owns everything they have. People that are...

getting into the fishery are borrowing large amounts of money; four, five, \$600,000 dollars, the banks want their money eventually... and if the prices of lobsters are down and your catches are basically holding the same...cost of everything is higher, you got less money, and you are not going to make it.

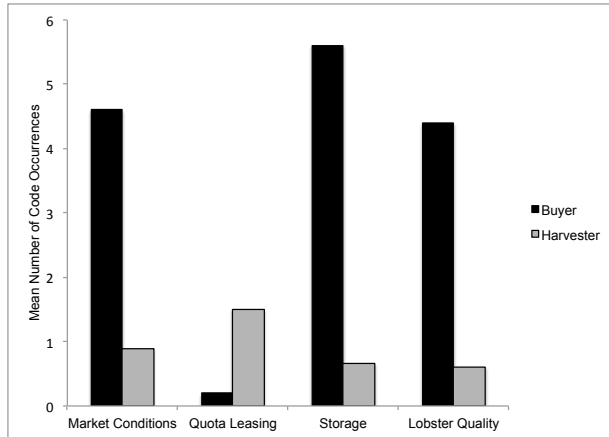
Some respondents suggest that these livelihood outcomes are more pronounced for crewmembers. For example, Jayden describes the effects of quota and license leasing on crewshares: “They’ve got such a high price tag on fish, for us to pay them and the owner of the boat, plus expenses, there is no money left for the crews. We’re paying out all this money, but the crew that wants to go fishing can’t make any.” Alternatively, Ethan suggests that “a lot of captains are taking less to try to keep the crews... cause if not... they’re not going to stay there.” Another account by Ryan suggests that some captains use employment in the lobster fishery as leverage to secure crew in less lucrative fisheries:

It is common for a captain tell crewmembers, “if you don’t go fishing, you don’t go lobstering.” Crew will make the most money from lobstering, and sometimes will not make anything from groundfishing, but if they want to go lobstering, they will put in the hours over the summer. Everyone in Alberta can tell you that story.

Additionally, Ryan links crew livelihoods to emigration, most notably to the tar sands of Alberta, where the oil business is booming. Captains must navigate the tradeoff between maintaining their boat and maintaining their crew, especially highly skilled crew. When boat shares are too low, a captain will not have enough reserve money saved up in the event of an engine blowout or damage to the boat or

pots, but when boat shares are too high, it is more likely that skilled crew will seek out another boat to work on, or emigrate.

## 5.5 Comparison of Buyers and Harvesters



**Figure 2:** Differences in the frequency of topics discussed by harvesters and buyers. All differences between buyers and harvesters are significant at  $\alpha = 0.05$ .

In this section I consider the possibility that harvesters, and buyers have contributed different sides or different pieces to the story based on knowledge of the conditions of their practices. In all cases, P-values are provided for the difference between buyers and harvesters in the number of times a given theme is mentioned, including a False Discovery Rate correction for multiple comparisons (see Figure 2). While buyers discussed market conditions ( $P = 0.01$ ), storage ( $P = 0.008$ ), and lobster quality ( $P = 0.01$ ) significantly more often, (4-6 times per interview), harvesters talked about quota leasing significantly more often ( $P = 0.03$ ). All other comparisons were not significant at  $\alpha = 0.05$ . It may be that more differences exist among buyers and harvesters, but the small sample size of buyers makes it difficult to observe these differences. Nevertheless, these results suggest a difference in perceptions of the problem. To harvesters, the challenges are focused on changing conditions of access rights to fisheries. To fish buyers, there is a localized challenge of improv-

ing the quality of lobsters and storing lobsters, but prices will not improve without a change in global economic conditions.

## 5.6 Barrington and Southwest Nova Scotia in Context

Barrett and Apostle (1992) describe a different outcome from the exploitation of open-access fisheries as that of Scott (1955) and Hardin (1968). In Nova Scotia, open access conditions for harvesters made the costs of entry low, but the risks associated with direct investment high. Additionally, small-scale or “artisanal” fishing fleets were more flexible, able to tailor their fishing practices to changing conditions, and were highly competitive, while the subsidized large-scale fleets could not reconcile short-term profits with longevity due to periodic episodes of overexploitation of stocks (Barrett and Apostle, 1992). Thus, the tragedy of open access was a tragedy for large-scale, vertically integrated industrial fishing fleets. Further, the characterization of the artisanal fleets as open access did not account for the various territorial and technology-based “gentlemen’s arrangements” and institutions documented in many regions of Nova Scotia among artisanal fleets (e.g., Davis, 1975, 1984b; Wagner and Davis, 2004; Ostrom, 1990).

The processes that have led to a current state of vulnerability in Atlantic Canada can be historically traced to the relationships between the colonies and Great Britain during the slave-trade era, which left a legacy of underdevelopment of Atlantic provinces and economic and political dependence of “have not” Maritime provinces on Ottawa (Innis et al., 1940; Rogers, 1998). The rapid post-war expansion of highly industrialized European freezer trawlers brought the Atlantic groundfish stocks to the brink of collapse in the 1970’s, leading to the 1977 declaration of the 200-mile economic zone (Rogers, 1998). Rogers (1998) demonstrates the contradictory Canadian policies of economic development of Atlantic provinces through the

expansion and subsidization of modern industrial domestic fishing fleets, and of the simultaneous regulation, control, and restriction of fishing effort to avoid a tragedy of the commons. As stated in the infamous Kirby report, while the DFO was “slowly tightening up the licensing regime with one hand (and preaching restraint), it was passing out subsidies for fishing vessel construction with the other, as were provincial loan boards” (Kirby, 1982, p. 20).

This rapid expansion of subsidized fishing effort, most notably from large corporate trawlers, such as those owned by National Sea Products, quickly ran into crisis as fishing overcapacity reached the natural boundaries of fishing grounds (Barrett, 1984). These boundaries were often obscured by increasing technical efficiency, which created the illusion of high productivity rather than high exploitative pressure on vulnerable stocks. By 1989, the Groundfish Task Force, estimated that the capacity of the fishing fleet exceeded economically efficient levels by five times (Hache, 1989). Individual transferable quotas were introduced in the form of “Enterprise Allocations” to a portion of the offshore groundfishing fleets (65’-100’ and <100’) as early as 1982, and Hache (1989) recommended the expansion of this regime to the smaller mobile and fixed-gear sectors. By 1991, individual quotas were introduced to the inshore mobile fleet (<65’), and a community quota system with an informal ITQ group was adopted by the inshore fixed gear fleet (<45’) in 1997 (Peacock and Annand, 2008; Crowley and Palsson, 1992).

Fishing capacity since the introduction of ITQs has decreased significantly among the fixed and <65’ mobile gear fisheries. For example, in Shelburne county, including Shelburne, Pubnico, and Barrington, the number of vessels decreased from 633 in 1996 to 156 in 2005 (Peacock and Annand, 2008). To some this, can be considered a rationalization of the fishery, wherein, the profit maximizing behaviors of individuals have been made to internalize exter-

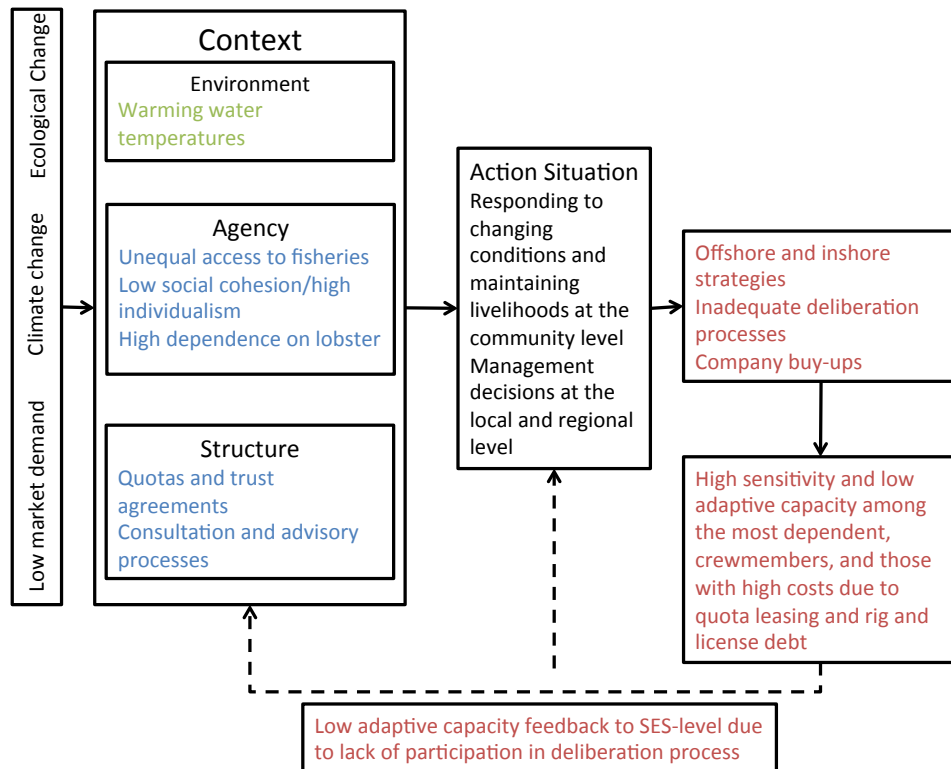
nalities through private property rights. This characterization, however, masks the heterogeneity of the groundfisheries of Nova Scotia. Davis (1996) suggests two essential categories of fishing have occurred in the region. The first is “accumulation fishing” with vertically integrated industrial vessels owned or subsidized by companies or nations, and using unselective technologies. The second is “livelihood fishg”, a practice that utilizes smaller-scale and selective technologies in long-enduring fishing communities with strong social ties. Davis (1996) argues that accumulation fishers can be characterized as predicted by common-pool resource theory, while livelihood fishers exhibit social and community-based restraints on fishing practices based on technology, community membership and participation, and local knowledge on what the grounds can take (Davis, 1996, 1984b).

While it is important to recognize that accumulation and livelihood fishing are extremes on a gradient, the most clear illustration of livelihood fishing is the handliner. Handliners frequently fish close to shore using simple technologies, a single line held in the hands with several baited hooks. Handline fishing strategies are cost-effective, flexible, and yield high-quality catches, with some vessels bringing in daily catches live. Many harvesters in Barrington pointed to the sea and remembered a time when they would see hundreds of handliners fishing within sight of the shoreline. During my fieldwork in Barrington, I only encountered three handliners who continued this practice, and all of them reported that they could not continue fishing with low quotas and a scarcity of fish inshore.

This brief historical overview of the SWNS multi-species fishery focuses on the groundfish collapse, and the social construction of the fishing landscape. Since government policies claimed regulatory control of all grounds within 200 miles of the shore, they have reproduced many of the dependencies from the colo-

nial era by incentivizing the rapid expansion of fishing effort beyond natural boundaries. By framing the problem as a tragedy of the commons to be solved through the creation of private property rights without an understanding of the differences among fishing practices, they incentivized the expansion of “accumulation” fishing, and ultimately, increased the vulnerability of small-scale inshore harvesters. Importantly, however, this historical legacy, I ar-

gue, is an important barrier to successful collective action in arenas that involve joint decision-making with government organizations. For those who were in the fisheries of SWNS in the times when groundfish was their primary source of income, there is a common perception that the actions of the government has directly resulted in a destruction of a “way of life” rooted in multi-species fishing within close-knit fishing communities.



**Figure 3:** A summary of the contextual interactions of environment, agency, and structures that have influenced the action situations and interactions of the SWNS multi-species fishery under conditions of double exposure.

## 6 Conclusions

Figure 3 summarizes the findings of this study. I use a combination of concepts from vulnerability and institutional analysis to demonstrate how regional structure (formal and informal

institutions, property rights, and the structure of the decision-making process), agency (harvesters, buyers, and government), and the environment have combined under conditions of double exposure to produce and reproduce re-

gionally specific action situations at multiple levels. At the local level, low social cohesion, high dependence on lobster, and low trust in government have reinforced an individualist approach to the current environmental context. Thus, harvester's direct their strategies towards catching more, decreasing costs, or investing in storage facilities, while largely refusing to participate in deliberation processes that are perceived to be illegitimate. Meanwhile, buyers or large fishing companies with sufficient economic and political capital have maintained their businesses by buying up quota, and by circumnavigating current rules that attempt to limit consolidation. Those with less political and economic forms of agency are more sensitive and have a lower adaptive capacity. These include those who fish lobster exclusively, those with high fishing costs due to debt and quota leasing costs, and crewmembers. Under these conditions, household level vulnerabilities have led to fragility at the SES-level due to a lack of participation in deliberation processes. This has created a regulatory rigidity, whereby changes are resisted on the grounds that outcomes will be negative, even if it is possible that some regulatory changes can bring positive outcomes. Any such regulatory changes however, would likely fail without procedural justice, a strong commitment to culturally appropriate understandings of equity, and an understanding of the diversity of strategies and social relationships that characterize communities (Davis and Ruddle, 2012; Davis, 1996).

In this paper, I have invoked the concept of the socially constructed adaptive landscape from McLaughlin and Dietz (2008); McLaughlin (2001, 2011), as well as Ostrom's (2009; 2007) diagnostic framework for SESs. These methods of framing have been useful for highlighting the interactions between the biophysical, the social and cultural, and the institutional processes of the system. In particular, McLaughlin (2001) complements the diagnostic framework by including a moderate form of con-

structivism. Under a moderate constructivist light, the Atlantic Canadian fisheries have been shaped by the forces of colonialism, appeals to high-modernism, and the perception of in-shore fisheries as a pending tragedy of the commons. This supports the characterization of Atlantic Canadian fisheries by Acheson (2006) as an example of "seeing like a state" (Scott, 1999). What is missing from this analysis however, is how current actors, such as buyers, wholesalers, mobile and fixed-gear harvesters, government agencies, and environmental NGOs have changed this perceived landscape. Additionally, to what degree does the framing and characterization of low lobster prices reflect the buyer's emphasis on external market conditions, or the harvester's emphasis on uneven bargaining power in the market chain. Resulting suggestions that reflect a buyers perspective will likely place the burden of adaptation on harvesters, suggesting methods for reducing catching capacity (e.g., quotas or buyback programs), or methods to sort for quality at sea. Suggestions that reflect harvesters would focus on dealing with the control of markets by large buyer or wholesalers, monopoly conditions at ports, and collusion among buyers. It is likely that any policy recommendations that do not address both concerns will be opposed by the group most burdened by those policies.

Households and institutions of SWNS are doubly exposed to a variety of processes caused by globalization and environmental change. First and foremost in this study, are processes that have led to low prices. Low market prices are the product of high catches due to trophic changes and climate changes which have increased the productivity of lobsters. Low demand conditions combined with abnormal water temperatures, especially in 2012, which altered the spatial and temporal distribution of soft or weak lobsters, and increased overall abundance at the beginning of the season. Thus, the livelihoods of harvesters in SWNS are teleconnected (Adger et al., 2008) at multiple

scales to financial institutions and their practices with regard to lending and the creation of complex derivatives, and the responses of home owners in the United States.

The current vulnerability of SWNS harvesters is the product of an adaptive response to previous vulnerabilities. As groundfish quotas and availability declined, many invested into increased capacity for lobster fishing by purchasing more efficient traps, bigger and more mobile boats, lobster storage facilities. Some who were too deeply embedded in the ground fish economy had to start anew, or enter into trust agreements to continue a livelihood in fishing. This adaptive response increased the overall capacity of the lobster fishery, resulting in higher sensitivity to gluts and low demand. Agricultural studies have also demonstrated how adaptations to stressors can create new biophysical and social conditions which result in sensitivities to future shocks (e.g., Adger et al., 2008; Eakin et al., 2013). Through global interdependence and teleconnectedness, the livelihood adaptations of Vietnamese farmers resulted in local deforestation while contributing to livelihood insecurity for Mexican coffee growers. This leads to further questions given the connections between the SWNS lobster fishery and the rest of Atlantic Canada, related global lobster fisheries, and the tar sands of Alberta. First, SWNS is the most productive lobster fishery in Atlantic Canada, and thus, gluts occurring there have wider implications for the livelihoods of harvesters in other regions. Additionally, markets for other lobster species influence, and are influenced by the market for the American lobster fishery, which is the largest lobster fishery in the world. Finally, those most vulnerable to double

exposure in SWNS have responded by emigration, most notably to work in the oil production industries in Alberta. To date, no studies have considered how or whether this flow of migrants has impacted the labor markets of Alberta, and what the implications are for these migrants, as well as their relatives who remain in SWNS.

Bacon (2005) notes that the effects of low coffee prices are amplified by the increasing concentration of stocks among a few transnational companies. A similar process of concentration among wholesalers was noted as early as 1984 by Steinberg (1984) in the multi-species fisheries of SWNS. To date, few follow-up studies have examined this commodity chain interdependency linking local communities to global markets. It is likely that understanding and addressing the imbalances in the commodity chain relationship would benefit the livelihoods of fishing communities as much as locally or regionally devised changes to the harvesting rules that focus on a tragedy of the commons.

Finally, this article provides supplementary and supporting evidence for similar processes occurring south of the Canadian-US border. Though the institutional structure is different in some important ways, Brewer (2011) found evidence of the consolidation of ownership of fishing access-rights, reduced accountability and transparency in quota fisheries, reduced flexibility of multi-species harvesters, and a lack of faith in the governance regime. Similar to Brewer (2011), I argue that current governance structures will only further current processes resulting in a loss of habitat, diversity of harvesting strategies and economic practices, local knowledge and ecological stewardship.

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## **A Semi-Structured Interview Protocol**

### **A.1 Local Expert Interviews (Government Officials, Quota Group Managers, and Lobster Association Leaders)**

1. What are the biggest challenges to the ability fishermen to maintain their livelihoods today?
  - (a) What changes have brought about these challenges?
  - (b) Is there anything fishermen are doing to respond to these challenges?
  - (c) What can they do to respond?
  - (d) What enables fishermen to respond in the way they do?
  - (e) What limits their ability to respond?
2. Based on your experience dealing with fish quotas, how have fish quotas changed the fishing industry?
  - (a) What percentage of fishing quota do active fishermen now own?
  - (b) How has this percentage changed since quotas were introduced?
  - (c) What has caused this change?
  - (d) Which types of fishermen and crewmembers have been most affected?
    - i. Which boat size classes?
    - ii. Which type of gear, longline, handline, dragger etc. . .
  - (e) What effects have these changes had on the fishing communities?
  - (f) How have fishing practices changed due to quotas?
3. Would you want to see any changes to the lobster fishing regulations?
  - (a) IF YES, what changes?
  - (b) What about the other quota fisheries?
4. Would you want to see any changes to the way regulations are made?
  - (a) Why would you want to see this changed?
  - (b) What about the other quota fisheries?
  - (c) Why would you want to see this changed?

## **A.2 Retired Fishermen's Interview**

1. When did you first start fishing for a living?
  - (a) When did you decide to retire?
  - (b) What motivated you to retire?
2. What species did you fish for (besides lobster)?
3. When you started fishing, what was the biggest challenge to your ability to make a living in fishing?
  - (a) What is the biggest challenge fishermen face today to make a living in fishing?
4. Since you started fishing, what changes have you seen in the lobster fishery?
  - (a) Do lobster fishermen fish differently today?
  - (b) How have the lobstering grounds changed?
5. What changes have you seen in the other fisheries you participated in?
  - (a) Are fish found in the same places?
  - (b) Are they as abundant as they used to be?
  - (c) What happened to you when these fisheries went to quota?
  - (d) Were you given a historical allocation that allowed you to fish the same?
6. When you retired, what did you do with your license and boat?
  - (a) Was it passed on to a relative?
  - (b) If your children or grandchildren could not inherit a license, would you say that they could still make a go at it?
7. What changes have you seen in your community?
  - (a) Do you think that people help each other out as much as they did in the past?
  - (b) In your opinion, why (do/don't) people help each other out as much?