“THEY HAVE CONTINUOUS LONG-TERM OBSERVATIONS, THEY KNOW WHAT'S GOING ON, AND THEY ARE CONCERNED”: CONNECTING COMMUNITY STEWARDSHIP TO WATER GOVERNANCE AND SOCIAL-ECOLOGICAL SYSTEMS IN NOVA SCOTIA

by

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To the women who made me who I am today: Grandma. Mom. Caitlin.

I love you all.

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ABSTRACT

Despite ongoing efforts to involve stewardship groups in decision-making around water, there is still no clear understanding of the importance of or potential roles for stewardship in shaping overall water governance in Nova Scotia, Canada. Rather, stewardship is largely limited to the context of water management, or "on-the-ground" activities. In order to address the complex, multi-tiered interactions between water governance and broader human-environmental issues, I set out two research objectives for this study:

1. Identify the roles of Nova Scotia water stewardship groups in the context of Social-Ecological Systems or SES (a way of conceptualizing human-environmental interactions); and,
2. Determine how individuals involved in stewardship view their roles in water governance.

Using an evolving research design, the results of the study provide insight into the ways that individuals involved in stewardship groups view their role in shaping broader water governance and addressing overall issues in human-environmental interactions.

LIST OF ABBREVIATIONS USED

AAAS	American Association for the Advancement of Science
ACAP	Atlantic Coastal Action Program
CBEMN	Community-Based Environmental Monitoring Network
CBM	Community-Based Monitoring
CCME	Canadian Council of Ministers of the Environment
CURA H2O	Community-University Research Alliance – H_2O
DFO	Department of Fisheries and Oceans (colloquial name for Fisheries and Oceans Canada)
DNR	Department of Natural Resources (colloquial name for Nova Scotia Department of Natural Resources)
EA	Environmental Assessment
IWRM	Integrated Water Resources Management
MLA	Member of the Legislative Assembly
MP	Member of Parliament
NGO	Non-Governmental Organization
REB	Research Ethics Board
SES	Social-Ecological System
SNA	Social Network Analysis
SSHRC	Social Sciences and Humanities Research Council of Canada
UN	United Nations
WWDR	World Water Development Report

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CHAPTER 1: INTRODUCTION

1.1. Introduction

This chapter provides an introductory overview to this thesis. It is composed of a problem statement, the research goals and objectives, and a brief literature review to place these topics into scholarly, geographic and social contexts.

1.2. Problem Statement

Nova Scotia is located on the east coast of Canada. Divided into two distinct landmasses – mainland Nova Scotia, and Cape Breton Island – the region encompasses an area 55,000 km^2 in size (Nova Scotia Museum of Natural History, 1996). There are 46 primary watersheds in the province, all of which drain either directly or indirectly into the Atlantic Ocean. Nova Scotia's political landscape has evolved in ways that do not necessarily align with its geographic and watershed boundaries. As a result, boundaries related to water overlap with other jurisdictional boundary objects – such as municipal borders, park boundaries, and indigenous reserves – creating unclear responsibilities for water issues in the province. In addition, water is not explicitly assigned to a governance entity – federal, provincial, municipal governments and their respective departments and agencies – in Canadian jurisprudence (Bakker & Cook, 2011). Consequently, there is a governance 'vacuum' regarding water in Nova Scotia. Several community-based environmental stewardship groups comprised of individuals from various backgrounds and experiences have attempted to fulfil some of the governance functions that have been neglected at a local level (Conrad & Hilchey, 2011). While Nova Scotia identifies stewardship as an important element of its provincial water strategy (Nova Scotia Environment, 2010), it is largely limited to the context of management, or 'on-the-ground' activities. Despite the efforts of the individuals involved in stewardship groups to become more involved in decision-making around water, there is still no clear understanding of the importance or potential roles of stewardship in shaping overall water governance in Nova Scotia.

At the same time, environmental stewardship and governance form part of the complex, multi-tiered interactions between human and environmental issues. One method of examining such interactions concurrently is through the use of Social-Ecological Systems or SES thinking (Berkes, Folke, & Colding, 1998). While SES can provide a guideline for analyzing human-environmental interactions, there is no clearly identified role for stewardship in many existing SES frameworks (Hinkel, Bots, & Schluter, 2014; Ostrom, 2009; Partelow, 2016; Thiel, Adamseged, & Baake, 2015). Rather, SES frameworks have tended to focus on the unique needs and characteristics of environmental 'users' as opposed to using much broader and more encompassing terms. In doing so, SES frameworks have been limited in understanding human-environment interactions beyond resource use, consumption, and dependency. As a constantly evolving framework, some of these limitations have been addressed in later iterations of the SES framework (i.e., by enlarging the category from 'users' to 'actors') (McGinnis & Ostrom, 2014). As such, SES remains a flexible tool for examining human-environmental interaction and environmental governance. Opportunities to further refine SES thinking to encompass broader issues in environmental stewardship and governance may be explored by examining it's application in other contexts, such as how water stewardship groups participate in governance processes.

1.3. Research Goals and Objectives

The goal of this study is to determine the potential roles for and influence of community-based water stewardship groups in Nova Scotia, Canada. My rationale for choosing this as the primary research goal is to understand stewardship within the much broader conceptual topics of water governance and human-environmental interactions. To achieve this goal, I set out to accomplish the following research objectives:

3. Identify the roles of Nova Scotia water stewardship groups in the context of Social-Ecological Systems or SES; and,
4. Determine how individuals involved in stewardship view their roles in water governance.

These research objectives provide the guiding framework for this study. To address them, I conducted multiple phases of data collection encompassing an online survey with individuals

involved in water stewardship groups and semi-structured interviews with a selection of respondents of the survey. I then employed different forms of qualitative data analysis on these data sets throughout the study. This research project was conducted over the course of several years and is detailed comprehensively in Chapter 2.

1.4. Literature Review

1.4.1. Freshwater and Groundwater Globally and in Canada

In 2003, the first World Water Development Report (WWDR) (United Nations [UN]: World Water Assessment Programme, 2003) highlighted the major trends, issues and problems with freshwater around the world. Three issues were emphasized in this WWDR: water scarcity; decrease in water quality; and water-related disasters. Water scarcity emphasized diminishing global freshwater through consumption and natural occurrences such as drought. Decreases in overall water quality pertained to human interactions with water, such as disposal of human waste, industrial pollution and storm-water/agricultural runoff. Water-related disasters – such as floods and severe storms – were presented as a key part of a growing global water crisis. The UN noted that solutions to these global challenges must incorporate small scale, local and regional responses. Thus, there is a growing need for better understanding of water issues at a community level.

Despite the seemingly vast amounts of water spread across a large geographic area, the perception of the abundance of water in Canada is largely a myth (Sprague, 2007). While Canada contains 7% of the world's freshwater, 25% of global wetlands, and a significant and diverse range of aquatic species (Environment Canada, 2005), fresh, clean and safe water is not equally distributed across the country, nor is it of the same quality in all areas (Natural Resources Canada, 2005). Like many other parts of the world, several regions in Canada face challenges in water quality and quantity (Foster & Sewell, 1981). However, as a result of the perception of seemingly endless supplies of water for Canada's relatively small population, water quality and quantity challenges are rarely felt by the majority of Canadians, as indicated by extremely high water usage patterns (Brandes, Ferguson, M'Gonigle, Sandborn, & POLIS Project on Ecological Governance, 2005). There are notable instances where these water-related inequalities have spurred stewardship activities in Nova Scotia and Atlantic Canada (Reed, 2013; A. Sharpe &

Conrad, 2006). These challenges present important contextual information with regard to how people view water in Canada. Nova Scotia in particular, faces numerous water challenges in various applications, such as recreational uses, drinking water, industrial uses, energy production, and even cultural/spiritual uses (Nova Scotia Environment, 2010). This is in addition to the natural, ecological functions of water. The perception of abundant water, coupled with the disparity in water standards, creates a need to better understand community-level responses to various water challenges in Canada.

1.4.2. Human-Environment Interactions and Social-Ecological Systems

At a broad conceptual level, analyzing the ways that human activity impacts environmental processes requires understanding of the spatial, temporal, and geopolitical scales of human-environment interactions (Olsson, Folke, & Berkes, 2004). The term Social-Ecological System, or SES, has been used to describe the specific integrated concepts of human-environment interactions (Berkes, 2004). While the term itself provides useful insight, as an analytical tool it links complex connections of different human-scale and environmental-scale concepts -- including resilience, adaptation, and transformation -- with social and ecological outcomes (Folke, 2010; Folke et al., 2010; Olsson et al., 2004; Walker, Holling, Carpenter, & Kinzig, 2004). While these terms have broad meaning, in the context of SES they entail specific theories for analyzing how the interactions between human processes and environmental processes function. The overall function of SES thinking is to develop flexible arrangements in translating human social concepts into better environmental practices through examples such as collaboration and co-management (Armitage et al., 2009). Ultimately, SES thinking entails linking human processes, such as community-building and governance, with desired environmental objectives.

There are many challenges to addressing environmental issues as part of a broader SES. These include challenges of scale, institutional rigidity, disruption, and inadequate information (Virapongse et al., 2016). Scale refers not just to the geographic size of a particular environmental issue, but also the institutional and political boundaries within them. Within these institutions, rigidity or complacency can stymie environmental outcomes. At the same time, environmental events can produce sudden and dramatic consequences, which can outpace the institutional responses to them. Finally, inadequate information refers to issues

regarding data collection, data analysis, aggregation, and reporting in environmental issues that can lead to misleading decisions and poor outcomes.

Ostrom (2009) provides a conceptual and analytical framework for examining how the various social and ecological concepts are inter-related and how the different processes at different scales can affect each other. The framework contains 53 interrelated variables organized within eight broad categories: (1) social, economic and political settings; (2) resource systems; (3) resource units; (4) governance systems; (5) users; (6) interactions; (7) outcomes; and (8) related ecosystems. Each of these categories, and in turn, the variables contained within them, is intended to represent a specific component of the much broader SES.

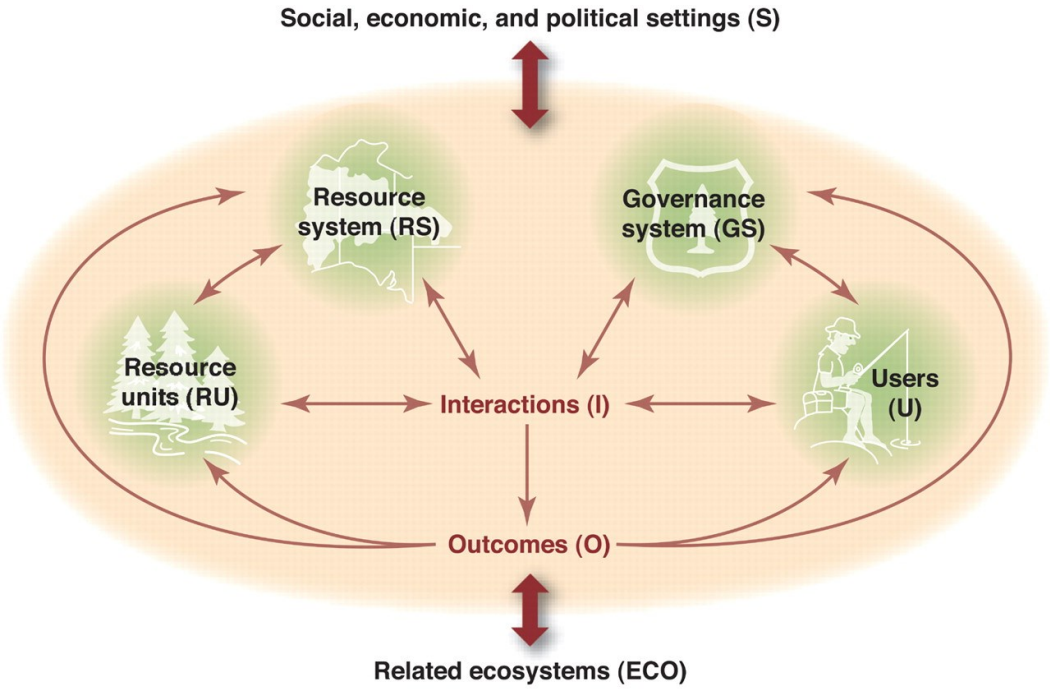

Figure 1: Relationship between core subsystems in a Social-Ecological System. From Ostrom (2009). Reprinted with permission from AAAS.

In addition to Ostrom's (2009) framework, which remains a useful tool in analyzing SES, Virapongse et al. (2016) describe SESs in similar terminology and propose additional characteristics for understanding the processes of SESs. Specifically, SESs are composed of: (1) a systemic worldview where the environmental issues are examined as part of a broader scale,

rather than in isolation; (2) transdisciplinary approaches where different areas of expertise are integrated; (3) co-development of knowledge where those considered 'non-experts' are still involved in knowledge generation; (4) stakeholder engagement where trust and understanding between multiple parties in environmental issues is established; (5) adaptive governance where individuals and groups that are interested are able to self-organize and are supported; and, (6) monitoring systems where thorough, reliable and relevant data is collected. These characteristics and processes are useful in analyzing environmental issues that span geographic, temporal, and institutional scales as they encourage environmental issues to be viewed in broad context, with implications in each of these areas as opposed to isolated issues.

As a result of the seeming comprehensiveness of SESs, studies have attempted to analyze environmental problems using SES frameworks, although with limited success in applying the numerous concepts and variables consistently (Thiel et al., 2015). With specific reference to stewardship, SES's early focus on one set of actors – namely environmental 'users' - has resulted in an emphasis on the process of "resource users extracting resource units from a resource system" as opposed to the multitude interactions that take place between different actors within an SES (McGinnis & Ostrom, 2014, p. 32)[2]. This lack of consideration of various social issues and social processes, or what Ban et al (2013) refer to as "the dynamic interactions between individuals, institutions, social organizations, and cultural norms" (p. 194), has resulted in a gap in understanding how SES can be applied to help facilitate solutions to environmental challenges. Consequently, while SES encompasses aspects of both environmental systems and governance systems (including a category for non-governmental organizations in Ostrom's 2009 framework), other missing 'social processes' of environmental issues – including stewardship – have created a limitation to how SES frameworks can be applied to understanding human-environmental interactions. Yet despite these early limitations, SES has remained one of the few adaptive, flexible tools available to analyze human-environmental issues in a cohesive, concurrent framework. Refinements to SES frameworks continue, with McGinnis & Ostrom (2014) addressing several limitations of earlier versions. Important refinements have included

[2] Some of these early limitations in Ostrom (2009) were addressed in McGinnis and Ostrom (McGinnis & Ostrom, 2014).

refining the 'users' variable into the more encompassing 'actors' term and re-defining the relationships between each of the parent-level variables. Opportunities for further testing and refinements remain and by examining environmental activities, such the as water governance roles of stewardship groups, the appropriateness of SES thinking in this context can be assessed.

1.4.3. Water Governance and Management

Research into water issues has often conflated the terms *governance* and *management* resulting in numerous challenges in developing policy tools and delegating decision-making accountability for water (Cohen, 2012). Bakker has differentiated these terms, suggesting that "water governance refers to the decision-making process we follow, whereas water management refers to the operational approaches we adopt" (2007, p. 16). Thus, in this thesis, *governance* refers to the political and institutional decision-making processes, while *management* refers to the operational and on-the-ground activities, whether conducted by experts, government, or private sector employees, or paid or volunteer community members. This distinct definition is also consistent with the usage of these terms by the National Roundtable on the Environment and the Economy (2011).

Another term propagated in water discourse is Integrated Water Resources Management (IWRM). IWRM is defined as taking into account the resources themselves, such as the quality and quantity of water, the needs and interests of the water users, the spatial scale of the managed area, such as a watershed or river basin, and temporal scales, such as long term water sustainability and seasonal water availability (Savenije & Van der Zaag, 2008). IWRM stresses the importance of scientific data, such as water quality, quantity, and availability, in management decisions (Stålnacke & Gooch, 2010). Despite the seeming comprehensiveness of IWRM, it is often conflated with water governance. Governance, however, distinguishes decision-making processes from the tangible actions of management (Cohen, 2012). The range of tools in Canadian water governance is largely dependent on the political context. Each province, city, and region may be subject to different rules, regulations and approaches to addressing water concerns. While water management is indicative of addressing quality and quantity concerns - including activities such as physical restoration, data collection and regulatory enforcement – water governance relates to the deliberative, and collaborative approaches to undertaking them – such as defining policy goals, information requirements, and evaluation criteria.

1.4.3.1. Transcending Boundaries: Challenges of Water

The complexity of water governance in Canada stems in part from the legal arrangements that have formulated throughout the centuries of evolution of Canadian jurisprudence (Saunders & Wenig, 2007). It is nearly impossible to understand the governance complexities of water without an understanding of the legal complexities and generally, water-related challenges in Canada – including issues such as water scarcity, and water pollution – have developed as a result of the broad social, political, and economic systems that have evolved throughout Canadian history (Brandes & Maas, 2006).

Many challenges in water governance stem from the broad legal concept of jurisdiction, which is the legal authority to make decisions for a policy area within a geographic area. Complicating water governance is that water itself is not static, but rather multi-faceted, and subjected to multiple human and ecological uses. Consequently, the varying states of water, combined with its seeming abundance in areas of Canada, transcends both political and geographic jurisdictions (Bakker, 2007; Saunders & Wenig, 2007). The most authoritative source of legal jurisdiction in Canada, the *Constitution Act,* specifies the responsibilities of the various levels of government in Section 91, 92 and 92A *(Constitution Act*, 1867). However, noticeably absent is any mention of "water". Rather, the responsibility for water is allocated to various departments and agencies at different levels of government through other jurisdictional areas such as: navigation and shipping, coasts and fishing, natural resources and forests, public lands, local works and utilities, and property. As a result, water governance in Canada is fragmented across geographic and jurisdictional boundary objects (Bakker, 2007; Bakker & Cook, 2011). While multiple suggestions -- including re-scaling the units in which governance systems operate -- have been suggested as a way to alleviate fragmentation of water jurisdictions, water governance remains a dynamic and challenging environmental issue (Cohen, 2012; Cohen & Davidson, 2011).

1.4.4. Community Participation in Water Issues

The role of communities in water issues is a central component of this thesis. Armitage (2005) notes that there is often an over-simplification in describing what 'communities' are. Often, they are defined as "a homogeneous unit with shared goals and values" (p. 705). Such homogenization presents challenges, however, when attempting to understand the variety and

diversity of approaches that communities and/or groups use in addressing water issues. Kearney and Berkes (2007) provide a more detailed characterization of 'communities' as containing fundamentally interdependent individuals and groups with differing power levels and views, as opposed to a singular homogeneous unit. This notion of 'interdependent communities' is a fundamental principle to understanding community participation in water governance as it considers the different perspectives that may not necessarily share similar backgrounds or views. Rather, individuals are mutually dependent on each other in a contextual setting. In addressing water issues, communities entail different combinations of governments, non-government organizations (NGOs), First Nations, academia, industries, and the private sector. The scale at which a 'community' operates is also largely dependent on the issue addressed.

In the Nova Scotian context, Community Based Monitoring (CBM) is a way of engaging communities in environmental issues (Conrad & Hilchey, 2011). It presents a local level response to addressing environmental issues (A. Sharpe & Conrad, 2006) and represents a participatory approach to water challenges that incorporates volunteers, citizen science and public engagement in decision-making. There are challenges, however, including: (1) volunteer fatigue, as most CBM is conducted by volunteers, which can lead to disinterest and fewer, less frequent monitoring activities; (2) potential for a lack of participant objectivity, causing bias in collected data; (3) lack of funding for equipment and other expenses; and, (4) potential for data fragmentation and inaccuracy, causing 'gaps' in consistent monitoring data (Cuthill, 2000; A. Sharpe & Conrad, 2006; Whitelaw, Vaughan, Craig, & Atkinson, 2003). These issues create uncertainty in the overall perception of community involvement in environmental issues as an acceptable scientific practice. Yet despite this uncertainty, it remains an important way of encouraging broader scientific literacy and public awareness of environmental issues (Perkins, 2011).

1.5. Geographic Context: Nova Scotia, Canada

The Province of Nova Scotia is located in eastern Canada and encompasses two main landmasses: mainland Nova Scotia, a peninsula situated between the Bay of Fundy, the Gulf of St. Lawrence and the Atlantic Ocean; and, Cape Breton Island, an island one kilometre to the northeast of the mainland and connected by a causeway. Nova Scotia is one of three 'Maritime'

provinces in Canada and directly borders only one other province - New Brunswick. No international borders are shared with Nova Scotia.

Much of the Nova Scotia landscape has been shaped by centuries of glaciation on the North American continent. As glaciers advanced and retreated, erosion and debris shaped much of what is now Nova Scotia. These areas of glacial debris created pockets of dense rocky landscapes, intertwined with over 6700 lakes, and hundreds of rivers and streams. Situated in a temperate boreal climate adjacent to the Atlantic Ocean, Nova Scotia experiences relatively mild winters and cool summers compared to other North American regions on the same latitude. Coastal weather patterns create abundant precipitation and seasonal variation in temperatures, which also affect rivers, lakes, and streams, with spring melting creating seasonal high-water periods. All 46 major rivers in Nova Scotia eventually drain into the Atlantic Ocean (Nova Scotia Museum of Natural History, 1996).

The population of Nova Scotia is approximately 920,000 people. Most (65%) of the population live in urban or peri-urban areas with a substantial population (390,000 people) located near Halifax, the capital city and administrative centre (Statistics Canada, 2011b). Cites and towns are primarily coastal. Historically, Nova Scotia's population consisted of indigenous Mi'kmaq peoples, Acadians (early French settlers), early Gaelic settlers, and Black Loyalists from the United States (Nova Scotia Tourism, 2016). While the demographic makeup of the province has changed, much of the province's population still identifies with its early Eurocentric origins (Statistics Canada, 2009).

The Nova Scotia Water Strategy, entitled Water for Life, outlines the current focus of water policy in Nova Scotia (Nova Scotia Environment, 2010). In addition, two subsequent reports have been produced that describe various milestones in four key areas: integrated water management, understanding the quality and quantity of water, protecting the quality and quantity of water, and engaging in caring for water (Nova Scotia Environment, 2012, 2014). *Water for Life* defines the current policy context of water issues in Nova Scotia and specifically is intended to formulate how local and provincial governments respond to water related challenges.

1.6. Format of This Thesis

This thesis encompasses elements of a traditional manuscript as well as a stand-alone paper intended for submission to a scholarly journal concerned with water stewardship and governance. Chapter Two details the methodological approach to this study, including detailed descriptions of the study design, data collection and analysis methods, participant recruitment and involvement, and overall research timelines. Chapter Three presents and discusses findings related to stewardship in the context of SES to address Research Objective 1. Chapter Four addresses broader issues in water governance as part of Research Objective 2. The chapter is intended as a stand-alone publication and encompasses detailed background, literature review and methods, findings, and discussion sections. Since the chapter is presented in publication format, it may have some repetition and resemblance to other sections and other chapters. Chapter Five provides a synthesis of the study's findings in relation to the research goals and objectives, notes strengths and limitations, and highlights potential directions for future research and potential implementation.

1.7. Chapter Summary

In this chapter, I introduced my thesis by providing a problem statement and a description of the research goals and objectives. I also provided a literature review into the major research areas that this thesis addresses. I concluded by describing the format of this thesis. In the following chapter, I describe the overall research design and methodology of the project in relation to the objectives of this thesis.

CHAPTER 2: METHODS

2.1. Chapter Introduction

This chapter describes the approach I took to conduct my research. Throughout the study, I attempted to determine the potential roles for and influence of community-based water stewardship groups in Nova Scotia, Canada. As part of the broader topics of human-environmental interactions and water governance, I sought to accomplish two main research objectives:

1. Identify the roles of Nova Scotia water stewardship groups in the context of Social-Ecological Systems; and,
2. Determine how individuals involved in stewardship view their roles in water governance.

In order to accomplish these objectives, I sought to use a mixed-methods approach. My approach originally encompassed a quantitative Social Network Analysis (Butts, 2008; Wasserman & Faust, 1994) and a Qualitative Case Study (Yin, 2003), two methods that have been utilized before in examining community-based approaches to natural resource issues (Guehlstorf & Hallstrom, 2012; Lauber, Decker, & Knuth, 2008; Plummer & Stacey, 2000; Stein, Ernstson, & Barron, 2011). However, as the main rationale and goals of this project evolved, I opted to focus more on the qualitative case study component of the study. This chapter describes the formation and evolution of these research objectives, data collection and analysis methods, ethical considerations, and timeline of my study, and provides justification for the methodological decisions and research objective revisions that I made as the study progressed.

2.2. Relationship to CURA H2O Research Project

My study was initially developed as part of a larger Community-University Research Alliance (CURA) funded by the Social Sciences and Humanities Research Council of Canada (SSHRC), entitled CURA H2O: Community-based integrated water monitoring and management in Nova

Scotia. Initiated in 2011, CURA H2O was a five-year project that sought to increase community capacity for integrated water monitoring and management in Canada and abroad. CURA H2O was a partnership between governments, NGOs, schools, the agricultural sector, academia, and community-based water stewardship organizations that aimed to address issues of capacity and credibility in CBM in three ways: (1) by developing a standardized water quality data collection and volunteer training system (WetPro) to meet government water monitoring requirements; (2) by integrating volunteer-collected water quality data into a database publicly accessible to governments, industries, and other organizations; and, (3) by researching CBM challenges and issues.

The research component of CURA H2O had four main themes: (1) CBM in Nova Scotia; (2) CBM Data Collection; (3) linkages between governments and CBM groups; and, (4) CBM and ecosystems. This study addresses, in part, the first and third themes, and aims to generate a better understanding of the state of CBM by exploring linkages among CBM groups in Nova Scotia and their connections with water governance. Although the funding period for CURA H2O has now ended, my research presented herein nonetheless contributes to its findings and the dissemination of them.

2.3. Research Design

2.3.1. Initial Mixed Methods Approach

I initially designed my study to incorporate a mixed methods approach. Designing the study using mixed methods enabled me to address the assumption that no research method or approach to an issue is truly impartial or complete (Greene, 2007). Combining elements of Social Network Analysis (SNA), and Qualitative Case Studies allowed me to apply tools and techniques from both quantitative and qualitative perspectives to my study. I selected these two research methods given the preliminary focus of my study on connections between organizations, individuals and environments. Initially utilizing multiple research methods invited “multiple ways of seeing and hearing, multiple ways of making sense of the social world, and multiple standpoints on what is important and to be valued and cherished” (Greene, 2007, p. 20). While I

later abandoned the SNA component, the initial study design incorporated both a SNA design and a qualitative case study design and both were important considerations in the overall construction of the study. Both methods had significant bearing on how participants were selected, data were collected and analyzed, and findings are reported. In this section, I briefly describe the strengths of these research methods and the rationale for selecting them.

2.3.1.1. Social Network Analysis

Social Network Analysis (SNA) focuses on the importance of relationships among interacting units (Wasserman & Faust, 1994). It is a distinct form of study because it provides a social sciences perspective that is not constrained by viewing independent individuals as units of analysis, but rather focuses on relationships and interdependencies between units (Provan, Veazie, Staten, & Teufel-Shone, 2005; Wasserman & Faust, 1994). In previous studies, SNA has been used as a way of determining how people and organizations, whether those organizations are governments, non-government organizations, or other institutions, work together to address natural resource and water issues (see for examples: Lauber et al., 2008; Stein et al., 2011). While Social Network Analysis is primarily a quantitative approach to analyzing relationships, its value in addressing environmental natural resource issues in social sciences is derived from being a well-grounded approach to analyzing interactions between the different actors involved (Bodin & Prell, 2011, p. 10). Wasserman and Faust (1994) highlight that distinctive terms, such as actor, relation, relational tie, and groups, for example, are needed to best understand the relationships between units. Such distinctive terms in a research method require that researchers explicitly define what might otherwise be considered metaphorical terms (Wasserman & Faust, 1994, p. 17). Bodin and Prell (2011) note that when using SNA to understand natural resource issues, it is best utilized in conjunction with another methodological approach to research.

Initially, I designed my study to incorporate SNA. However, this approach was eliminated from the study after receiving a low response rate to the survey described in section 2.5.1, which precluded any form of statistical analysis. In section 2.7.1.1, I describe the process of revising my

overall research questions and methods to accommodate the lower than anticipated response rate, while allowing for the qualitative use of the survey-response data.

2.3.1.2. Qualitative Case Study

Qualitative research aims to describe human environments and experiences (Winchester, 2005). It is an iterative process, requiring constant interpretation and revision, where the goal of the research is to view the world through the perspectives of the people involved (Bryman, Teevan, & Bell, 2009). The emphasis of research is placed on defining context and process over creating generalizable and replicable results, thereby creating significance in each study's own right (Bryman et al., 2009; Winchester, 2005). I utilized this approach because it complements the SNA approach of understanding relationships and connections, can build on the existing personal relationships that the CURA H2O team has with community partners, and values the perspectives of the people involved in water stewardship programs.

Nova Scotia presents a unique context for community-based water monitoring programs. Research conducted prior to the formation of CURA H2O has revealed that Nova Scotia has a well-developed and active volunteer water quality monitoring community (Conrad, 2006; A. Sharpe & Conrad, 2006). In addition, a government policy document, Nova Scotia's Water Resource Management Strategy (Nova Scotia Environment, 2010), has highlighted the need to support community-based monitoring. These background resources, combined with the relatively small size and regionally-concentrated population of Nova Scotia, provide for a provincial-scale case study that is *practical* and *appropriate*, which Bradshaw and Stratford (2005) note as two important elements in selecting a case study.

2.4. Project Timeline

Early in the study, I constructed a research timeline as part of my research proposal. Preliminary work on this study began in Fall 2012 and Winter/Spring 2013. Primary data collection began in summer 2013 and was ongoing throughout Fall 2013. Data Analysis occurred in Winter Spring of 2014 with subsequent analysis occurring following a leave of absence. Various stages of writing

occurred throughout, up until completion of this thesis. A detailed timeline of events is listed in APPENDIX I.

2.5. Data Collection

Primary Data Collection took place in two successive phases. The first phase was an online survey of individuals involved in community-based water stewardship groups in Nova Scotia. The second phase entailed follow-up semi-structured interviews with survey respondents who indicated that they would be willing to participate in an interview session. Phase 1 corresponded to research objective 1 by attempting to elicit the working relationships between stewardship groups as part of an interconnected SES, and thus intended to provide data for SNA. Phase 2 corresponded to research objective 2 by gathering the perspectives of key individuals involved in various groups, thus intended to provide data for the qualitative case study. In the following sections, I describe each of these data collection phases as linear and successive processes. However, the phases in fact were more iterative, with Phase 1 data informing elements of Phase 2 and vice versa. Furthermore, when I abandoned the quantitative SNA analysis, the data collected in phase 1 was repurposed to inform a more qualitative analysis of the various relationships and governance issues among stewardship groups.

2.5.1. Phase 1: Determining Relationships Between Water Stewardship Groups in the Context of SES

2.5.1.1. Online Survey

The first portion of data collection consisted of an online survey to elicit connections between organizations (see: APPENDIX II). An online survey allowed me to reach a large and geographically diverse group of participants fairly quickly (Bordens & Abbott, 2008, pp. 262–263). This type of survey is called a *saturation survey* (Hawe, Webster, & Shiell, 2004). The survey was constructed, distributed, and reconciled using the *Opinio* survey management software available through Dalhousie University. The option to use a paper copy of the survey was also made available, whereby respondents would mail back responses, and I would manually input them into *Opinio* on their behalf. Organizations that responded to the survey

were assigned an identifying code (e.g., SV-1, SV-2, SV-3) in order to distinguish responses during the reporting process.

2.5.1.1. Recruitment of Online Survey Participants

Recruitment of participants for the online survey was conducted using a combination of *purposeful sampling*, selecting participants based on their specific characteristics; *convenience sampling,* selecting participants on the basis of access; and *opportunistic sampling*, selecting participants based on new leads discovered over the course of the research process (M. Bradshaw & Stratford, 2005). A list of water stewardship groups was created by a member of the CURA H2O project. This list was developed by CURA H2O and the Community-Based Environmental Monitoring Network (CBEMN), and included publicly available contact information, such as email addresses and telephone numbers, for each CBM group. In addition to this list, I undertook a web search to verify group contact information.

While the initial list encompassed several groups in the Maritime Provinces, I limited my recruitment of potential participants to individuals and groups that are based in Nova Scotia. The reason for this was that past research integral in the formation of CURA H2O had been conducted with the assistance of community partners that operate in Nova Scotia (see: Conrad, 2006; A. Sharpe & Conrad, 2006), and consequently, Nova Scotia presents a uniquely practical context in which to examine water stewardship. I further limited potential participants to those from organizations that had an active email address so as to facilitate the use of the *Opinio* survey software, which utilizes email addresses to manage and track survey respondents. In total, 104 email addresses were selected as potential contacts.

Thus, the inclusion criteria for recruiting participants were that individuals have an e-mail address and are a part of a water stewardship group that (a) is located in Nova Scotia, (b) conducts some form of stewardship activity (including water quality monitoring – the focus of CURA H2O), and (c) relies, in part, on volunteers. These criteria were self-assessed, meaning that the individuals determined whether or not they and the groups to which they belong met them. Some potential respondents requested clarification on whether or not they met the criteria,

while others declined to participate because they felt they did not meet the selection criteria. In total, survey invitations were sent to 102 individuals representing 79 community-based water stewardship organizations in Nova Scotia.

2.5.1.2. Online Survey Questions

Potential respondents to the survey were asked to provide information about their organization, and to describe their role in their organization. Since the primary purpose of the survey was to elicit information on relationships between stewardship groups, the survey asked respondents to identify from a list the other organizations with which their organization is connected. This survey process is known as using a *roster* – or list of entities with potential relationships to each other – to elicit descriptive relationships between groups (Wasserman & Faust, 1994). Respondents were given a definition of 'connection' adapted from Lauber et al. (2008), which describes connections as relationships for exchanging ideas, disseminating knowledge, providing funds, providing other tangible resources, and exerting influence. The survey also contained a place for respondents to identify other organizations that were not on the list, a procedure that Hawe et al. (2004) identify as using *name generators*. Thus, the survey was designed as a 'mixed-method' questionnaire, encompassing both open- and closed-questions, to be used for both quantitative and qualitative analyses (McGuirk & O'Neill, 2005). Close-ended questions required respondents to choose from a list the other organizations their organization was connected to; and, open-ended questions provided opportunities for respondents to elaborate or clarify their responses in the form of free text responses. Both types of questions were used in my quantitative and qualitative assessments of responses. In addition, respondents were asked if they were willing to take part in a follow-up interview session.

2.5.1.3. Survey Setting: Multiple Reminders

Conducting the survey online allowed me to reach several potential respondents fairly quickly. Initial distribution of the survey took place in August 2013. Potential respondents received an email invitation with a link to the online survey. Two different initial invitations were created, one for individuals from organizations that are CURA H2O partners and one for individuals from other organizations. While fairly similar, the initial invitations tailored to CURA H2O partners

contained a slightly more personal tone as these organizations are already known to CURA H2O and were already aware of the nature of the study. Multiple reminders were used for survey invitations (Schirmer, 2009): one week after the distribution of the initial invitation, a reminder was sent out to respondents who had not yet completed the survey; and, an additional reminder was distributed three weeks after the first reminder.

2.5.1.4. Profile of Respondents

Immediately following the initial invitation, 20 survey responses (19%) were returned as 'undeliverable' to the recipient or as automatic 'bounce-back' messages. In total, after reminders, 29 individuals (28%) responded to the survey invitation; however, four of these did not complete the survey, and an additional two indicated that they did not meet the criteria for the study. I omitted these latter responses; thus, 23 individuals (22%) completed the survey, consisting mostly of Managers/Directors/Coordinators/Presidents/Chairpersons, but also a few staff and volunteers (Table 1).

Table 1: Profile of Respondents

Survey ID	Number of Years Organization has been Established	Role of Respondent
SV01	50	Manager/Director/Coordinator/President/Chairperson
SV02	18	Manager/Director/Coordinator/President/Chairperson
SV03	42	Staff Member
SV04	23	Volunteer
SV05	25	Manager/Director/Coordinator/President/Chairperson
SV06	20	Manager/Director/Coordinator/President/Chairperson
SV07	16	Manager/Director/Coordinator/President/Chairperson
SV08	7	Manager/Director/Coordinator/President/Chairperson
SV09	15	Manager/Director/Coordinator/President/Chairperson
SV10	27	Manager/Director/Coordinator/President/Chairperson
SV11	17	Manager/Director/Coordinator/President/Chairperson
SV12	8	Manager/Director/Coordinator/President/Chairperson
SV13	25	Manager/Director/Coordinator/President/Chairperson
SV14	7	Manager/Director/Coordinator/President/Chairperson

Survey ID	Number of Years Organization has been Established	Role of Respondent
SV15	30	Manager/Director/Coordinator/President/Chairperson
SV16	20	Manager/Director/Coordinator/President/Chairperson
SV17	9	Volunteer
SV18	2	Staff Member
SV19	15	Manager/Director/Coordinator/President/Chairperson
SV20	17	Volunteer
SV21	19	Manager/Director/Coordinator/President/Chairperson
SV22	39	Volunteer
SV23	3	Manager/Director/Coordinator/President/Chairperson

2.5.2. Phase 2: Participants' Views of Water Stewardship in Overall Water Governance

2.5.2.1. Semi-Structured Interviews

The second part of my study utilized semi-structured interviews to elicit perspectives on the roles of water stewardship groups in overall water governance. Semi-structured interviews, in contrast to structured or unstructured interviews, utilize a pre-determined set of and order of open-ended questions, but also allow for flexibility to explore issues addressed by the participant (Dunn, 2005).

2.5.2.1. Recruitment of Participants

Interview informants were selected from amongst individuals who responded to the survey, as these individuals were aware of the study and had already demonstrated a willingness to take part in it. Before finishing the on-line survey, respondents were given a brief description of what the interview would entail and asked to indicate whether or not they would be interested in participating in a follow-up session for the study. Respondents who indicated that they would be interested were placed on a list of potential interview informants. Some survey respondents indicated that someone else in their organization may be the best person to participate in an

interview session, which led to a more opportunistic approach to recruitment. These persons were subsequently approached by email or telephone to gauge their interest in participating.

2.5.2.2. Interview Guide

An interview guide was developed to explore issues in community-based water stewardship, volunteer participation, and strength and types of relationships between different groups (see APPENDIX III). The purpose of the interview guide was to serve as a prompt for key issues and themes throughout interview sessions with participants (Dunn, 2005). The interview guide consisted of 17 primary questions and 14 secondary questions structured around four issues: organization profile, water monitoring and stewardship activities, volunteer participation, and community connections and social benefits. The interview guide was ordered so that broad, general questions about the participant and his or her organization were asked first, and more specific questions were asked later. The purpose of this ordering of questions was to establish *rapport* with participants (Dunn, 2005). Because of the requirement to be flexible in semi-structured interviews, not all questions were asked the same way in all interviews, and at times questions that were not originally listed in the interview guide were asked (Bryman et al., 2009).

2.5.2.3. Interview Setting

Interviews were conducted over the telephone, allowing me to speak with participants without physically travelling to them, between October 2013 and March 2014. Interviews took place on weekdays, although I had provided participants the opportunity for alternate scheduling if more convenient for them. A digital audio recorder was used to record interviews with the consent of participants. While originally scheduled for 30-45 minutes, interview length ranged from approximately 25 minutes to one hour. For interviews that extended past 45 minutes, participants were asked if they were willing to continue.

2.5.2.4. Profile of Informants

Nine informants participated in an interview session, representing nine stewardship groups from various geographical regions in Nova Scotia, including urban and rural areas. The organizations

range in size and scope, with some well established, organized and funded, and others operating on a seasonal or project-by-project basis, with active volunteers as needed.

Table 2: Summary of Interview Informants

Informant	Pseudonym	Role in Organization
IN1	Sarah	Senior Volunteer
IN2	Alan	Senior Volunteer
IN3	Emily	Manager
IN4	Peter	President
IN5	Mark	President
IN6	Derryl	Staff Member
IN7	Leah	Staff Member
IN8	Edward	Board Member
IN9	Luke	President

2.6. Research Ethics

This study was approved by the Dalhousie University Social Sciences and Humanities Research Ethics Board and the Saint Mary's University Research Ethics Board. The nature of my involvement the CURA H2O project, as a graduate student at Dalhousie University being jointly-funded through both Dalhousie University and Saint Mary's University, required that ethics approval be obtained from both institutions' Research Ethics Boards (REBs). APPENDIX IV includes the certificates of approval from both institutions' REBs.

2.6.1. Confidentiality

Identifier codes and pseudonyms were used rather than names. No identifying information from participants was or is available to anyone other than my supervisory committee and me. However, it is possible, in the small and inter-linked CBM community, that participants' identities might be guessed or deduced, as someone may recognize their responses. In all publications, reports and presentations, participants are not identified by name, but rather by a unique identifier, pseudonym or role in their organization.

2.6.2. Informed Consent

Participants were informed that their participation in this study is completely voluntary. Before responding to the survey, respondents were presented with a web page outlining the nature of the study and provisions for confidentiality. Potential respondents were then given my contact information, as well as contact information for members of my supervisory committee and Dalhousie University REB, for use in the event that they had questions or concerns. Potential respondents were then asked to for their consent prior to participating in the survey. Later, before interviews were conducted, informants were reminded, through the use of an informed consent script, that their interview participation was also voluntary and that they could withdraw themselves or their data from the study at any point until the data were analysed and reported.

2.7. Data Analysis

Similar to how I described data collection methods in Section 2.5, in this section, I describe data analysis methods as a linear process for the purpose of clarity. However, the actual process of data analysis was highly iterative and reflective with multiple procedures informing each other over an extended period of time. Furthermore, as noted, I revised my data analysis plans after I determined that the response rate to the online survey was too low to support a statistically robust quantitative SNA.

2.7.1. Survey Data

Phase 1 survey responses were organized into three categories of usable data: organization profile, social network analysis, and free-text qualitative responses. Organization profile data consist of the number of years the organization has been established, the approximate number of personnel involved with the organization, and the role of the respondent in the organization. These data were sorted by category in a spreadsheet and provided reference information for my use during interviews later in the study. Social Network Analysis data consisted of responses that indicated ‘connections’ to other organizations. Using these data, I attempted to generate a quantitatively representative visualization of the overall ‘network’ of water stewardship groups

(Bodin & Prell, 2011; Stein et al., 2011). However, similar studies conducted using social network analysis data in environmental issues (Lauber et al., 2008; Prell, Hubacek, & Reed, 2009; Rathwell & Peterson, 2012; Stein et al., 2011) all achieved significantly higher response rates – between 80% and 90%. As a result of the comparatively low response rate (28%) in this particular phase of my data collection, I abandoned this method of data analysis. Finally, I categorized other free-text responses by organization and key theme and used these themes in refining the research questions and shaping interviews with participants in Phase 2, and as data for qualitative analyses of stewardship characteristics in water governance.

2.7.1.1. Research Question Revision

While the response rate I received (28%) was characteristic of an online survey, it did not permit the use of the Social Network Analysis method to address the research questions that I had originally proposed (i.e., What is the overall state of linkages between water stewardship groups in Nova Scotia; and, how do individuals and CBM groups become more connected, and engaged in environmental issues?). Consequently, I faced a decision to either (a) reconstruct or redefine the boundaries of the network that I aimed to examine by refining what inclusion criteria I used to define an 'actor' within the network, or (b) revise my research questions and methods to ones more suited to the response rate and the particular data set I had thus compiled. After exploring the literature, I could find no justification for changing the characteristics of an 'actor' within the network that would both accomplish the objectives of the study and withstand methodological scrutiny. In addition, as I had exhausted opportunities to recruit new participants through the use of multiple survey reminders, I decided to revise (a) the research questions to those listed at the introduction to this chapter and (b) the methods to focus on qualitative analysis of the compiled data set. Thus, while the results encompass a wide range of perspectives and experiences, they cannot be considered statistically representative of the entire population of water stewardship groups involved in water monitoring in Nova Scotia.

2.7.2. Interview Data

I transcribed interviews verbatim. Following the transcription process, I contacted each of the interview participants and asked if they would be interested in verifying, reviewing and making

changes to their transcripts. Three participants made minor revisions and corrections to their transcripts. Following this verification period, I conducted a qualitative content analysis of the interview data. Content analysis allowed me to identify specific terms, phrases, and ideas as well as the context in which they appear (Cope, 2005). I used a combination of deductive and inductive approaches to thematically analyze the data contained in interview transcripts (Fereday & Muir-Cochrane, 2006), and multiple rounds of analysis. I used Nvivo 11™, a Qualitative Data Analysis software, to assist in keeping track of my insights and processes.

2.7.2.1. Deductive Coding

I began by examining interview data using the social-ecological sustainability framework established by Ostrom (2009), which contains 53 sustainability variables organized within eight inter-related categories: social, economic and political settings; resource systems; resource units; governance systems; users; interactions; outcomes; and related ecosystems (Table 3). This framework provided me with a basis for understanding the various factors in social and environmental interactions. Using Nvivo 11, I assigned a 'node'[3] to each of these variables, which established my initial coding scheme for assessing the interview data (Table 3). I then categorized sections of text into one or more of these 53 codes. This process allowed me to understand the ways in which interview informants conceptualize the various issues in environmental stewardship as they relate to social-ecological sustainability. In addition, I was able to determine how the conceptual ideas are inter-related.

Table 3: Summary of Social-Ecological System variables from Ostrom (2009) used as 'nodes' for coding interview data

NODE NAME	DESCRIPTION
ECO - Related Ecosystems	Ecosystems that are not necessarily within the analytical context of the given social-ecological system (ie: external to the study area).
ECO1 - Climate patterns	
ECO2 - Pollution patterns	
ECO3 - Flows into and out of focal SES	

[3] 'Node' is the Nvivo terminology for a specific code used to match sections of text.

NODE NAME	DESCRIPTION
GS - Governance Systems	Organizations and rules that govern the use of a resource within a larger system.
GS1 - Government organizations	
GS2 - Nongovernment organizations	
GS3 - Network Structure	
GS4 - Property-rights systems	
GS5 - Operational rules	
GS6 - Collective-choice rules	
GS7 - Constitutional rules	
GS8 - Monitoring and sanctioning processes	
I - Interactions	Connections or exchanges between variables.
I1 - Harvesting levels of diverse users	
I2 - Information sharing among users	
I3 - Deliberation processes	
I4 - Conflicts among users	
I5 - Investment activities	
I6 - Lobbying activities	
I7 - Self-organizing activities	
I8 - Networking activities	
O - Outcomes	Results or performance measures within the system.
O1 - Social performance measures (e.g. efficiency, equity, accountability, sustainability)	
O2 - Ecological performance measures (e.g. overharvested, resilience, biodiversity, sustainability)	
O3 - Externalities to other SES	
RS - Resource Systems	The context in which resource units are situated.
RS1 - Sector (e.g. water, forests, pasture, fish)	
RS2 - Clarity of system boundaries	
RS3 - Size of resource system	
RS4 - Human-constructed facilities	
RS5 - Productivity of system	
RS6 - Equilibrium properties	
RS7 - Predictability of system dynamics	
RS8 - Storage characteristics	
RS9 - Location	
RU - Resource Units	

NODE NAME	DESCRIPTION
RU1 - Resource Unit Mobility	Singular units (i.e., a single species) within the context of a resource system.
RU2 - Growth or replacement rate	
RU3 - Interaction among resource units	
RU4 - Economic value	
RU5 - Number of units	
RU6 - Distinctive markings	
RU7 - Spatial and Temporal distribution	
S - Social, economic and political settings	The context in which users are situated.
S1 - Economic development	
S2 - Demographic trends	
S3 - Political stability	
S4 - Government resource policies	
S5 - Market incentives	
S6 - Media organization	
U - Users	Individuals who take part in the processes of a resource within a system.
U1 - Number of Users	
U2 - Socioeconomic attributes of users	
U3 - History of use	
U4 - Location	
U5 - Leadership or entrepreneurship	
U6 - Norms or social capital	
U7 - Knowledge of SES or mental models	
U8 - Importance of resource	
U9 - Technology used	

I also examined interview data for four different categories of 'connections' that I derived by synthesising concepts in the existing literature: group-to-group connections (Lauber et al., 2008), group-to-individual connections (Stadel & Nelson, 1995), group-to-broader community connections (Bliss, Aplet, & Hartzell, 2001), and group-to-environment connections (Rathwell & Peterson, 2012). I assigned codes to each of these categories (Table 4) and re-analyzed interview transcripts to assign relevant sections of text to one or more of these codes. This process of using multiple coding schemes allowed me to develop and explore further analys using different sets of codes that emerged within the data.

Table 4: List of variables related to 'connections'

NODE NAME	DESCRIPTION
Connections to Broader Community	Connections to different constituent groups (not necessarily related to water/environmental stewardship)
Connections to Individuals	Organization connections to specific individuals (such as a particular member, or a volunteer(s))
Connections to Natural Environment, Resources and Ecosystems	Mention of a specific aspect of the environment or an environmental process
Connections to Other Organizations	An instance where a member from describes working with another organization.

2.7.2.2. Inductive Coding

Following this process, I undertook an additional round of coding to capture unanticipated themes emerging from the data. For this round of coding, I used an inductive approach of categorizing sections of interview text into key themes. Using information from academic literature in water stewardship issues, as well as from the free-text responses from the survey conducted in Phase 1, I generated a preliminary list of possible ideas that might emerge within the data. This process generated an initial list of what I call *primary*, theory-driven, or pre-determined codes (Table 5). As I scanned through interview texts looking for sections of text that fit the categories of these primary codes, I also developed a list of *secondary*, or data-driven, codes (Table 6). These codes consisted of ideas, expressions, or sentiments that I recognized that were not captured in the initial list of primary codes. Following this, I began to cluster codes into similar categories to generate overall themes within the data and explore the relationships among them.

Table 5: List of Primary-level nodes

NODE NAME	DESCRIPTION
Activity	*The things that an organization does*
Capacity	*The ability of an organization to conduct activities*
Demographics	*Characteristics of participants involved in the organization*
Development	*Reference to a particular development (i.e., construction, housing)*
Organization Lifespan	*How long the organization has existed*
Students	*Any reference to students*
Water Governance and Jurisdiction	*Reference to decision-making processes, institutions*
Youth Engagement	*Engagement with young people*

Table 6: List of secondary-level nodes

NODE NAME	DESCRIPTION
Advisory Council Members	*Description of an advisory group, committee, etc.*
Communication	*Interaction of some sort with other organizations or the general public*
Conciliation	*Mitigation of conflict or distrust*
Engagement Approaches	*Ways that organizations relate to or engage with the public or other organizations/institutions*
Formation Challenge	*Challenges of organization formation*
Formation Story	*Description of how the organization was formed*
Funding	*References to funding*
Issue or Event	*Reference to a specific environmental incident or environmental incidents*
Organization-developed Tool or Product	*Tool/product that an organization itself has developed*
Other Challenges	*Challenges that may not necessarily fit into other categories*
Project Leadership	*Actions that are led by an organization itself*
Reasons and Rationale	*Justification for why organizations conduct activities*

NODE NAME	DESCRIPTION
Success Story	*A particular accomplishment of an organization*

2.7.3. Synthesis of Results in Relation to Research Objectives

With the results I derived from these various data sets and analytical methods, I conducted a further synthetic analysis to answer the research questions. I organized the codes and sub-codes according to the strength and nature of their relationship to the two research objectives (Table 7). I then grouped them to different categories in order to generate themes, which in turn address the research objectives of this study (Fereday & Muir-Cochrane, 2006).

Table 7: Themes in relation to Nodes and Research Questions

EMERGENT THEME	RELATED NODES	RESEARCH OBJECTIVE RELATIONSHIP
Participants' views on the "life" of and success of stewardship groups	Formation Challenge	Research Objectives 1 & 2
	Formation Story	
	GS - Governance Systems\GS2 - Nongovernment organizations	
	I - Interactions\I3 - Deliberation processes	
	I - Interactions\I4 - Conflicts among users	
	I - Interactions\I7 - Self-organizing activities	
	Organization Lifespan	
	U - Users\U5 - Leadership or entrepreneurship	
The role of stewardship groups as a key component of broader community involvement in water issues	Activity	Research Objective 1
	Communication	
	Connections to Broader Community	
	Connections to Individuals	
	Connections to Natural Environment, Resources and Ecosystems	
	Connections to Other Organizations	

EMERGENT THEME	RELATED NODES	RESEARCH OBJECTIVE RELATIONSHIP
	Engagement Approaches	
	I - Interactions\I2 - Information sharing among users	
	I - Interactions\I3 - Deliberation processes	
	I - Interactions\I6 - Lobbying activities	
	I - Interactions\I7 - Self-organizing activities	
	Project Leadership	
	Reasons and Rationale	
	Students	
	Success Story	
Challenges and opportunities, both internal and external, of maintaining stewardship	Demographics	Research Objective 2
	Funding	
	GS - Governance Systems\GS1 - Government organizations	
	GS - Governance Systems\GS7 - Constitutional rules	
	I - Interactions\I3 - Deliberation processes	
	I - Interactions\I4 - Conflicts among users	
	I - Interactions\I7 - Self-organizing activities	
	Other Challenges	
	Other Challenges\Competing Priorities	
	S - Social, economic and political settings\S2 - Demographic trends	
	U - Users\U2 - Socioeconomic attributes of users	
	Water Governance	

2.8. Reporting Findings

Over the course of conducting my study, I had many opportunities to engage with participants and interested individuals in both formal (i.e. interviews, conference presentations, and seminars/webinars) and informal ways (i.e. emails, telephone calls, and face-to-face meetings). Before beginning data collection, I was able to interact with several water stewardship groups

through the CURA H2O project. Events such as research committee meetings allowed me to build a network of contacts. Throughout data collection and analysis phases, many individuals contacted me, by email and by telephone, interested in my study and eager to share and discuss the process and latest findings. I also participated in several volunteer events with many water stewardship groups with participants of this study. In the spring of 2014, I, along with the three other graduate students working on other CURA H2O research themes, organized a webinar discussion forum to share findings with community stewardship groups from Nova Scotia and across Canada. All of these events allowed me to share the results and findings of this study at various stages of the research process.

2.9. Researcher Positionality

I grew up in Toronto, Ontario in a largely urban environment with little exposure to environmental issues. My original interest in this topic of community stewardship stems from my passion for outdoor recreation and education-based activities. Having connection with for nature and outdoor environments through wilderness canoe tripping. My experiences in the outdoors, however, were only subtly related to environmental stewardship through developing a personal set of best practices that I acquired over the course of several trips. It was largely in conjunction with my formal education where I began to develop a stronger interest in and better understanding of human and environmental interactions. Throughout my undergraduate studies at York University, my original interest was in political science and global institutions. In my third year, I began pursuing courses in Geography and Canadian Studies. Through these fields of study, I developed an interest in environmental studies because it allowed me to explore concepts such as the role of place, which I encountered as a facilitator of outdoor programs. In my fourth and final year, I opted to convert my degree program into a double major in Political Science and Canadian Studies. My decision to pursue graduate work in environmental studies led me to Dalhousie University in Halifax, Nova Scotia.

I did not complete an undergraduate thesis, and this has been my first attempt at managing an original research project. When I first arrived at Dalhousie University in September 2012, I

approached Dr. Heather Castleden, and then later Dr. Cathy Conrad, with an interest in water issues, which stemmed from my experiences canoeing in Ontario. Dr. Castleden and Dr. Conrad introduced me to the CURA H2O project and guided me through the development of my own research questions and objectives.

As someone who is not from Nova Scotia, I came into this field of study with a perspective of a largely urban, Ontario-born and raised individual. I consider this important because as I have met with and interacted with survey respondents and interview participants in this study, I have encountered perspectives on issues with which I would otherwise not have been aware. The perspectives of these individuals have continuously shaped and reshaped the way in which I understand the issues in my research project.

Between 2014 and 2016 I took an extended medical leave of absence from my graduate studies. While I continued to engage with my research project in a limited capacity, I was no longer actively involved with the study itself or the CURA H2O project. When I resumed my role as a graduate student, I did not have the same network of relationships with the individuals who were originally involved in crafting this study. I was, however, able to seek new insight with others and to revisit sections of my project with a fresh perspective.

2.10. Chapter Summary

In this chapter, I described my research design processes, data collection and data analysis methods that I used in my study. I provided the rationale and justification for the use of these methods, as well as accounted for the various decisions that I have made throughout the study. In subsequent chapters, I present the comprehensive findings of my study in the form of a stand-alone chapter on stewardship in the context of SES and a manuscript on linking stewardship to water governance for submission to an academic journal.

CHAPTER 3: STEWARDSHIP IN THE CONTEXT OF SOCIAL-ECOLOGICAL SYSTEM SUSTAINABILITY

3.1. Introduction

In this chapter, I report the experiences of the water stewardship groups involved in this study in the context of a Social-Ecological System (SES) framework. This chapter primarily relates to Research Objective 1: identifying the role of stewardship within the broader conceptual topic of SES. These findings, while linked to the findings discussed later in Chapter 4, emphasise stewardship as a form of human-environmental interactions. While the topic of Research Objective 2 – their role in water governance – is briefly discussed here, the focus of this chapter is on interactions between people and the environment in the broader context of a larger system. Following a summary of the findings, I provide a discussion on the implications and importance of these interactions in relation to the broader concept of SES and to the overall objectives of this thesis.

3.2. Stewardship in the Context of Social-Ecological System Sustainability

Ostrom's (2009) framework for analyzing the sustainability of SES can provide general insight into human-environmental interactions (Ban et al., 2013). However, the framework contains a limitation in addressing human-enviornmental interactions beyond resoure use and consuption (Ban et al., 2013; McGinnis & Ostrom, 2014). While Ostrom's (2009) framework contains 53 sustainability variables organized within eight broad categories: social, economic and political settings; resource systems; resource units; governance systems; users; interactions; outcomes; and related ecosystems, it typically has been limited to addressing issues of resource use, although later iterations of the framework have addressed this in part (McGinnis & Ostrom, 2014). As described in the methods section (Chapter 2), each of these SES variables was assigned a unique identifying code (Table 13) in order to determine whether stewardship can enhance undertanding of the processes of human-enviornmental interactions beyond resource use. I then analyzed interview transicrips using a deductive coding method by matching sections of

text to one or more of these codes. In further analyses of grouping and clustering codes, I focused on three variables that were most frequently referenced by interviewees – Governance Systems, Interactions, and Users – and the overlapping references within them. This section describes the findings contained within these codes (including within the overlap between them) and how they relate to the processes inolved in SES.

Governance Systems refer to specific organizations that implement rules around a resource (in the context of this study, water) and the processes in which these rules are created. Participants described several views of governance systems, including the role of different organizations, and the various formal (e.g., legislation, by-laws) and informal (e.g., best practices, community standards) rules that relate to water. These tended to be context specific (i.e. rules that applied to one organization, or to one situation did not necessarily apply to another). Prominent examples that participants noted were municipal programs and by-laws that applied to one stewardship group operating within a geographic area. In contrast, programs scaled to the provincial level applied to stewardship groups in all of Nova Scotia, without a specific municipal boundary constraint.

Coded text references focused on 'Non-government organizations' (28 references), 'Government organizations' (19 references), and on 'Monitoring and sanctioning processes' (15 references) indicating a link between stewardship groups, governments and the various activities that each performs. With respect to 'Non-government organizations', participants described their governance roles primarily in relation to the various projects they undertake, such as stream restorations and clean-ups, that organizations do, as well as the number of organizations performing those activities in each geographic area. References to 'Non-government organizations' in some cases also referred to other organizations (i.e.: funding agencies, charities, etc.…) with which stewardship groups were involved but that didn't necessarily have an environmental focus. Regarding 'Government organizations', participants described the roles of federal, provincial, and municipal levels of government as well as the various departments within them. In describing 'Monitoring and Sanctioning processes',

participants referred to the different tools, procedures, and approaches that nongovernment and government organizations use in conducting stewardship activities.

Interactions are the various relationships and exchanges within an SES. This can encompass exchanges between the various stakeholders within the system (Individual/Group Users or Resource Units) and components of the system itself (e.g. Governance Systems or Water Resource Systems). Most participants' comments in the *interactions* category focused on Self organizing activities (64), Networking activities (50), and Information sharing among users (44). Remarks related to 'Self-organizing activities' highlighted the ability of people within a stewardship group to conduct trainings with interested individuals or conduct some form of activity (e.g. restoration or monitoring and sampling) when an issue occurred. 'Networking activities' referred to meetings with people external to the stewardship group, whether other stewardship groups, or outside individuals. 'Information sharing among users' described the ways in which different groups share knowledge, findings or practices. Of particular importance in this category was the way in which training programs and data were utilized as part of water stewardship.

Users refers to the people involved in a particular Social-Ecological System, drawing on it in some way (Ostrom, 2009). Participants primarily described various issues around 'Leadership or entrepreneurship' (25), 'Technology used' (24), 'Socioeconomic attributes of users' (22), and 'Norms or social capital' (19). In highlighting 'Leadership or entrepreneurship', participants again described the various projects and programs that community members are involved in that relate to water issues. For example, descriptions of activities such as stream clean-ups, and deadfall/branch removal, and rock/boulder moving often referred to the organizational and leadership abilities of the individuals involved – usually a coordinator or leadership figure. The 'Technology used' in these activities varied and consisted of basic tools (e.g. shovels, crow-bars, hoes) and more advanced instruments (automated water testing probes, pH testing kits, and computer software applications). 'Socioeconomic attributes of users' referred to various characteristics such as the age and gender of stewardship group members, while 'Norms or

social capital' referred again to the activities of the stewardship group, but also the enabling circumstances that allow the stewardship group to undertake the activity (e.g. having funding to buy equipment, having enough volunteers available).

3.2.1.1. Overlap between Governance Systems and Users

Interview coding revealed 23 instances where references to 'Governance Systems' and 'Users' overlapped. These references of text simultaniously referred to both the 'Governance Systems' and 'Users' variables and were coded accordingly. When combined and grouped together, overlapping coded references can reveal broader 'themes' in interview text references (Fereday & Muir-Cochrane, 2006). Combining and grouping the various references in this overlapping region revealed three broad themes in the overlap between 'Governance Systems' and 'Users': (1) stewardship-group-led advocacy, (2) government-led discussions, and (3) data transmission. In this case, 'themes' revealed specific types of proceedings that occur in the overall stewardship processes. While these were generated from synthesizing references that overlap the 'Governance Systems' and 'Users' codes, they also broadly address other variables within the SES framework (Lobbying Activities, Deliberation Processes, and Information Sharing, for example). These results are summarized in the following subsections.

Stewardship group-led advocacy

In the context of stewarardship group-led advocacy, participants listed examples of how they, and the organizations they are involved in, interact with the people and institutions of governance systems to adress an issue that users may feel passionately about.

> *We started liaising with Halifax Water and HRM about the water quality concerns and it's slowly evolved into […] building relationships with Nova Scotia Environment, our MLA, MP, our local councillor, HRM, Halifax Water. (IN2 – Alan, Interview)*

Well some of the issues that we push for would be usually on the municipal level but sometimes on the provincial level as well, basically pushing for more environmental regulation. (IN6 – Derryl, Interview)

It's always important to have good relationships with government and all sorts of other stakeholders. I find personally I have pretty good relationships with the government and the employees around here. They know us, we know them. (IN5 – Mark, Interview)

These examples of environmental issues being addressed through stewardship-group led advocacy are wide ranging and include pollution, aquatic habitat destruction, and general water quality and quantity concerns. While participants' remarks described stewardship-group advocacy as a bridge between 'governance systems' and 'users' in the context of addressing these specific environmental issues, these themes also relate to other concepts in the SES framework, namely I6: Lobbying activities. However, 'lobbying activities' were not conducted directly by 'users' but rather by third-party stewardship-groups. In addition, the role of stewardship seemingly extends beyond those of GS2: Non-government Organizations, since – while a subtle distinction – Non-government Organizations can encompass other, non-stewardship-related organizations as well.

Government-led Discussions

Regarding 'government-led discussions', one participant referred to the importance of having the people and institutions of 'governance systems' initiate meetings to discuss environmental issues. Often the knowledge, expertise, and rationale of individuals with decision-making capacity can be shared or passed to individual resource users through stewardship groups. At the same time stewardship groups can liaise with other individuals involved in 'governance systems' who may have similar policy objectives and can offer insight into how to accomplish those objectives.

In the fall, Nova Scotia Environment organized this meeting and the folks came down here and we talked a bit more about getting volunteers and they did have this vision and they made a very good point about, basically, 'old Mark running around 16 lakes is not a sustainable model'. You have to have local people on site. So, I took it a bit more seriously this year (IN5 – Mark, Interview).

Data Transmission

In mentioning 'data transmission', participants referred to the importance of communicating the results of their activities to other individuals and institutions within the overall 'governance system', whether government organizations, nongovernment organizations or the appropriate enforcement or regulatory body.

We would […] go collect bacteriological samples. In all cases that we've done that, we haven't had to go further. We've found that the results are within the CCME[4] recreational water quality guidelines. But the idea was that, if there was an issue, we would pass that forward to HRM and the health authorities to deal with it further. (IN2 – Alan, Interview)

While not necessarily in the context of passing data for a specific 'governance system' purpose (e.g. enforcement), other participants echoed the importance of data collection and retention for a broader benefit (e.g. public education).

[4] CCME refers to the Canadian Council of Ministers of the Environment, an intergovernmental body that establishes water quality testing guidelines. The recreational water quality guidelines include the following parameter areas: microbiological (including fecal coliforms), chemical, temperature, clarity, pH, turbidity, oil and grease aquatic plants, aesthetics, and nuisance organisms (Canadian Council of Ministers of the Environment, 1999). See: https://www.ccme.ca/

Well they started the data collecting in late 2007, so since then, water quality monitoring occurs bi-weekly and then once a month, we take grab samples and we take two maximum for analysis, so of course with that, we have quite a bit of data. We do keep a database and we have been working actually on creating a public database off our website. (IN7 – Leah, Interview)

3.2.1.2. Overlap between Interactions and Governance Systems

Interview coding also revealed references where 'Interactions' and 'Governance Systems' overlapped. Further theme generation and analyses within these overlapping references revealed four themes – in this case, organizational activities that participants described: (1) Internal Deliberation, (2) External Outreach and Cooperation, (3) Awareness Building, and (4) Environmental Action. These ways that stewardship organizations interact with members, seek and solicit cooperation with other groups, perform restoration and monitoring tasks, and communicate with the broader community illustrate how stewardship groups address a particular issue or challenge in the context of a SES. Interviewees also revealed these processes as essential components of addressing issues and challenges of environmental governance.

Internal deliberations

Regarding internal deliberations, participants described the importance of keeping individuals involved in stewardship engaged in the various activities that organizations conduct. Participants accomplished this through the use of regular meetings and events to discuss the internal working of an organization, as well as deliberations on the various issues that arise.

At our Annual General Meeting we would invite members of the community and other guests to our AGM and we would talk about things that we've done throughout the year […] and provide information as to why we're doing these things as well. (IN2 – Alan, Interview)

An issue arises and the organization will meet – the board, and/or the board and the community – and will take input from the community members about any particular issue. (IN4 – Peter, Interview)

External outreach and cooperation

In addition to the internal deliberations, participants also referred to the importance of extending relationships to outside organizational members. There are numerous purposes to this type of external outreach and the types of external partnerships can range from working with like-minded organizations in order to accomplish a particular objective, or to working with outside agencies that seek to influence (e.g. through funding programs) specific political or environmental outcomes.

And then, in terms of working with other groups, I mean, we certainly try and come to a consensus. We try to work through a process where we're working as partners in all aspects. So, we provide our knowledge and our strategies, and they're all based in science and best management practices and current regulations and policies that the different organizations that we interact with might have. (IN2 – Alan, Interview)

And some of them team up with other organizations or are committees of big organizations. In [one town] for example, they did a lot of work within the estuary and then the freshwater brook. And they would have done some kind of water quality training. Some of the groups also do CABIN[5] as an indicator of water quality. (IN3 – Emily, Interview)

[5] CABIN refers to the Canadian Aquatic Biomonitoring Network, a program established by Environment Canada

Awareness building

With regard to 'awareness building', participants stressed the importance of communicating the value of stewardship organizations in addressing environmental issues. Specifically, this included describing the various public services that stewardship groups provide.

> *They tend not to go to the municipality or the province because a lot of people are frustrated with them. If they see silt running in the river, they know it's coming from developments. Or, they see the developer cutting right out to the river and not honouring, or not leaving a buffer, they will call the province, they will call the municipality, and nothing happens. So, purely out of frustration, they'll come to us. (IN6 – Derryl, Interview)*

> *Another part of the communication would be, if there is an issue that we see, we would report those issues to the authorities that have jurisdiction on those issues. So an example would be: we saw some illegal dumping of some carpet cleaning fluid into a catch basin, and so we report that. At the same time, we express our displeasure with that and inform the people that some law or something is being broken here. So I think that's part of the education, too. It just shows people about the issues. It points out the issues to the community and shows that there's some awareness as well. (IN2 – Alan, Interview)*

Environmental actions

Finally, participants described environmental actions as a form of overlap between 'interactions' and 'governance systems'. These environmental actions range in the goals and types of actions that each organization conducts but can generally relate to a specific, tangible objective such as collecting information, or performing some sort of clean-up, or stocking activity.

We've now established a regular sampling routine […]. We are taking a number of sampling locations down the lake at different depth intervals and we would collect information on pH, conductivity, dissolved oxygen, what's the other one... total dissolved solids, salinity at one metre depths at different sampling stations around that lake to get a sense of the profile and the stratification of the lake in terms of those parameters. (IN2 – Alan, Interview)

Our activities are based on Atlantic Salmon – i.e. improving Atlantic Salmon habitat, improving habitat conductivity, fish passage. We also do an annual stocking each year, as much as we can, unfortunately only with trout, in conjunction with Nova Scotia Department of Fisheries. (IN6 – Derryl, Interview)

When these concepts are revealed through the insight of participants, they begin to form a basis for understanding how stewardship interacts with the overall SES framework. Stewardship activities replicate some characteristics of 'governance system' functions within this framework, such as by establishing nongovernmental organizations (GS2), working with government organizations (GS1), and collecting monitoring data (GS8). At the same time, stewardship group 'interactions' highlight the supporting functions that stewardship groups conduct, such as sharing information (I2), lobbying (I6), self-organizing (I7), and networking (I8), as a means to address governance challenges.

3.2.1.3. Overlap between Interactions and Users

Results of interview coding also revealed overlap between 'Interactions' and 'Users'. Theme generation within this overlap revealed three areas of practice that stewardship groups operate: (1) labour efforts in pursuing an environmental goal; (2) research and the pursuit of knowledge and insight into environmental issues; and, (3) the coordination of users' multiple interests and points of view.

Labour Efforts

In addressing the roles of stewardship groups, participants described how the various events that organizations conduct allow individuals to participate in some sort of purposeful activity. While the definition of 'purposeful' in this context is not precisely defined, participants referenced employment and volunteerism as important ways that stewardship organizations involve individuals. However, a challenge that participants identified with associating stewardship with labour efforts was the shortage of people who were willing to engage in the various stewardship activities for extended periods of time. This is consistent with other findings on 'burnout' when primarily relying on volunteers and the same individuals to conduct environmental activities (Byron & Curtis, 2002; Byron, Curtis, & Lockwood, 2001).

> *I see our organization as a conduit for providing employment, not just for children or young people like yourself, but for some other people in the community who might be interested in making a few months' wages. But, boy, it's hard to get [young people] to work for us. (IN4 – Peter, Interview)*

> *Well, so we have a core group. And basically, within the core group, there's at least 15 of us that are very active. And that would mean that we are participating in some activity within the group at least on... two or three times a month. (IN2 – Alan, Interview)*

> *We have some volunteers that are very strong, are very active; we have some that sort of come and go. (IN6 – Derryl, Interview)*

> *Well, for the most part, our projects are implemented through students, and those students are usually hired, sometimes starting in May, most of them go through to the end of August, and of course, they're all returning students, so they go back in September. (IN6 – Derryl, Interview)*

Research and Pursuit of Knowledge

Participants referred to the importance of addressing environmental issues within a community through scientific, issue-based research. These environmental issues that arise can spur a stewardship organization to seek out the tools, methods, and the expertise to understand the causes of the issue and the potential solutions. In these examples, participants referred to how community members' interactions with the environment can spur research into a specific issue.

> *One thing that I heard, and what I think was the main concern is, is that people were saying was that, they were seeing more algae in the water. And this lake is an oligotrophic lake, so it has pretty clear water for most people standing. But for people who lived around the lake for a long time, they were noticing changes. I'm not sure if it was slime on the rocks or if it was the colour of the water. I'm not really clear myself what those changes were, but people were saying that they were seeing changes in the water. (IN1- Sarah, Interview)*

> *On occasion we would get someone in the community say, "I'm getting swimmer's itch; there seems to be a lot of algae; I have a concern, you know, a health concern". So, we would respond to that and go collect bacteriological samples. In all cases that we've done that, we haven't had to go further. We've found that the results are within the [Canadian Council of Ministers of the Environment] recreational water quality guidelines. But the idea was that, if there was an issue, we would pass that forward and the health authorities to deal with it further; and we would alert our members if there was any issue, there (IN2 – Alan, Interview).*

Coordination of Users

Finally, participants also addressed the importance of coordinating multiple different users and groups of people. There were two types of coordination that participants discussed:

coordinating people and coordinating similar organizations. In both cases though, this involves ensuring that individuals, both within and external to a formal stewardship group, can access other like-minded groups.

> *We've been getting a lot of phone calls: "they're cutting too close to the river", "they're not maintaining any kind of buffer". We also have a new development going in on a lake as well. We've had a lot of people that became members just to voice their concerns about that. (IN6 – Derryl, Interview)*

> *Some of our members have worked with [another organization] in the lakes and rivers in what you call the Southwestern Biosphere zone – the five western counties of Nova Scotia. We're on one end and they're up in the other end [of the region]. The other thing is we're old and slow and a little less energetic - but maybe wise! But, them? They're young and full energy, which is great! (IN5 – Mark, Interview)*

These themes portrayed in the overlap between 'Governance Systems', 'Users', and 'Interactions' begin to illustrate how interviewees distinguish between the concepts of water resource stewardship and water resource use. For example, interviewees stressed the importance of teaching and enabling (U8), having the right tools (U9), and leadership (U5) as part of cultivating stewardship as a way of thinking. Interviewees also revealed the various investment activities (I5), self-organizing activities (I7), and networking activities (I8) that stewardship groups take part in. Stewardship in this sense doesn't necessarily 'come naturally' to resource users, but rather is something that must be taught and enshrined as a way of thinking and as a practice separately from using and consuming a resource.

3.3. Discussion and Conclusion

Examining coded references provided insight into the potential roles, interactions, and finally the importance of stewardship in relation to the broader conceptual topic of SES. These potential benefits extend beyond traditional resource 'users'. Rather, they are part of the SES as multi-tiered interactions at both human scales and environmental scales. For instance, while traditional resource 'users' can be described as individuals who partake in activities with regard to a natural resource, stewardship – as described by interviewees – extends beyond those individuals and encompasses both the water resource system, and a broader societal element. The benefits of stewardship likewise have both an environmental and societal level benefit - such as curtailing illegal activity. Finally, the examples provided by interviewees produced another clearer distinction between stewardship groups and user groups. User groups, such as angling clubs and fishing associations, are primarily concerned with the use of a water resource, while stewardship groups are primarily concerned with the long-term health and viability of water itself.

> *It's called the Watershed Society, as opposed to an angling club, because when they formed the association it was in response to some issues with the river wandering and meandering, destroying a lot of farmland. They formed this association with the idea that the river depended on so many other things - land usage, forestry practices, anything. The end result is the river gets impacted, but they were concerned with anything. (IN4, Peter)*

Overlapping references in the 'governance systems', 'interactions' and 'users' codes begin to identify potential roles for stewardship organizations within the context of Social-Ecological System. These roles can be described as: (1) undertaking *events* – where stewardship groups undertake a specific task, (2) participating in *activities* – where stewardship groups involve themselves in ongoing series of events and (3) performing within an *area of practice* – the ongoing overall objectives of a stewardship group in relation to the events and activities. These

three roles formulate the potential basis of integrating stewardship into the broader SES framework.

Table 8 - Examples of how "events", "activities", and "areas of practice" can be used to categroize stewarsdhip roles in SES.

Event	**Activities**	**Area of Practice**
- Removing garbage from a river	- A “clean-up” weekend - Fundraising for equipment - Community Organizing Meetings	- Restoring a watershed

Current literature exploring the framework of SES emphasizes the importance of generating a broad understanding of environmental issues. However, prior to the development of Ostrom’s (2009) framework, much of the literature centered on two distinct themes: social, and biological/ecological. Berkes (2004), and Olsson, Folke, and Berkes (2004), outlined social elements of SES, while Walker, Holling, Carpenter, and Kinzig (2004) described biological and ecological elements of SES. While there is some utility in conceptualizing these two elements as unique parts of a bigger system, flexibility is required in order to develop the necessary social and institutional arrangements needed to address ongoing social-environmental challenges (D. R. Armitage et al., 2009). Ostrom’s (2009) SES framework provides a general outline for linking both human and environmental interactions in a common system of understanding.

While SES thinking can enhance understanding of human-environmental interaction, limitations of SES thinking have already been identified in numerous case studies. For example, Folke (2010) identifies the problem of ‘fit and lock in traps’ where human actions are unresponsive to changing environmental conditions as a result of insufficient institutional capacity and rigid governance systems. Similarly, Young (2002) describes the problem of institutional ‘interplay’ where the various institutions which are devoted to a specific area of a SES encroach, overlap, and in some cases contradict each others’ efforts. Stewardship aims to break these cyclical kinds of problems by providing insight into ecological, environmental, and governance processes from

the perspective of both users and non-users of a resource. Another challenge is that the dynamic nature and multiple uses of water create limitations to the applicability of SES thinking. Specifically, whether water is perceived as a universal right to which everyone has access (Campese, 2009; Perry & Kite, 1999), or a natural resource subject to societal, political, and economic controls (Brandes & Nowlan, 2009; Weber, 2001), can influence the applicability of SES thinking in a water stewardship context. Since this either-or dichotomy is specific to water 'users' – as in, water belongs to one of these categories only in the sense of its human uses - there is little room for the application of stewardship, or the many other non-human uses of water (e.g. ecological functions of water).

Participants in this study illustrated examples of 'Users' and 'Governance-Systems' and 'Interactions' in the SES framework. When analysed by grouping and combining references, the themes generated represent ways in which individuals perceive their involvement in designing, developing and delivering stewardship programs that meet both social and ecological goals. One notable participant described his experiences starting a program within a stewardship group to monitor water quality (and other management practices) and having this program evolve into broader areas of public engagement.

> *We decided to start researching water quality, fish stocking, best management practices; we started liaising with [the municipality] about the water quality concerns; and it's slowly evolved into programs- sampling programs and some setting goals around public education, community involvement, working with other likeminded groups or associated groups and organizations, building relationships with Nova Scotia Environment, our MLA, MP, our local councillor. (IN2 – Alan, Interview)*

One recommendation derived from this study is to explore the potential for adding additional stewardship-focused variables in the context of Ostrom's existing SES framework. In the 2014 update of Ostrom's 2009 framework, a similar change was made to incorporate the function of other 'actors' beyond resource 'users' (McGinnis & Ostrom, 2014). This change allows for

addition expansion of individuals beyond resource 'users' by further incorporating stewardship-focused variables. In practice, this may include the addition of stewardship as a new parent variable, and the events, activities, and areas of practice as new sub-variables. Scholars and practitioners would then have the ability to further distinguish between 'stewardship' groups and other resource 'users' or 'actors' using an SES framework. In addition, the various roles that each entity is capable of in managing and governing SES could also be further clarified without necessarily narrowly categorizing stewardship as a user or 'non-government organization'. Given their very specific roles in performing environmental and social services, categorizing stewardship within the existing variables within the 2009 SES framework presents a challenge as variables such as 'non-government organizations' are too broad to encompass the events, activities, and areas of practice of stewardship. However, the development of stewardship as an additional variable, and events, activities and areas of practice as sub-variables, in the context of SES also requires further research and consideration.

CHAPTER 4: "THEY DON'T NECESSARILY LISTEN TO US, BUT AT LEAST THEY TAKE NOTICE": THE ROLE AND INFLUENCE OF COMMUNITY STEWARDSHIP GROUPS IN WATER GOVERNANCE IN NOVA SCOTIA, CANADA

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4.1. Statement of Student Contribution

Jeff Blair conducted primary research design, data collection and analysis, and wrote and revised this manuscript. Heather Castleden provided supervisory oversight of the research process, funding contributions to the study, editorial comments and suggested revisions. Karen Beazley and Tony Walker provided additional supervisory oversight, editorial comments and suggested revisions.

4.2. Abstract

The role and influence of stewardship groups in water governance in Canada is often overlooked in favour of more operational, 'on-the-ground' management activities, typically conducted by experts, government or private sector employees, or paid staff or volunteers. Yet, in Nova Scotia, Canada, there are many well-established community-based water stewardship groups (i.e. non-profit organizations) that also operate in the context of water governance – that is, participate in the deliberative and decision-making processes around water issues – despite financial, logistical, and human resource challenges of doing so. Using semi-structured

interviews with key individuals involved in these groups, five key storylines emerged regarding the role of stewardship overall water governance in Nova Scotia: (i) the role of incidents in group formation, (ii) the activities of stewardship groups, (iii) the process of formally organizing, (iv) the ways in which groups describe success, and (v) the ongoing challenges of stewardship groups. These storylines provide a narrative of how stewardship groups both participate in overall water governance in the Province of Nova Scotia and navigate complex governance issues, namely the devolution and divestiture of overall water responsibility to numerous levels of government (and the departments and agencies within) – and the preference for involving stewardship in management activities instead of in conjunction with broader water governance.

4.3. Introduction

Community stewardship activities are an important way of engaging the general public in environmental issues (Carr, 2004; Dickinson et al., 2012; Shirk et al., 2012; Wagenet & Pfeffer, 2007). These activities have the potential to benefit governments, decision-makers, and the broader community, in addition to natural environments and ecosystems themselves (Conrad & Hilchey, 2011; O'Neill, McKim, & Rainer, 1995). Whitelaw, Vaughan, Craig & Atkinson (2003) describe the activities, and specifically monitoring, conducted by community stewardship groups as processes "where concerned citizens, government agencies, industry, academia, community groups and local institutions collaborate to monitor, track and respond to issues of common community concern" (p. 410). These processes allow for ordinary citizens, in most cases volunteers, who sometimes lack technical expertise in environmental issues or scientific methods, to undertake activities that would normally be conducted by 'experts'. While the development of such groups increases the level of citizen engagement in environmental issues, criticisms and challenges of stewardship raise important questions regarding the role that stewardship groups can have in broader environmental issues. These well documented criticisms include that: community stewardship is ineffective in addressing local issues; it has the potential to create frustration and disenchanting results (Goodlad, Burton, & Croft, 2005); and, the use of volunteers introduces unpredictable and uncertain elements into environmental stewardship (Scott & Herman, 1995). At the same time, challenges in community stewardship

include volunteer burnout, issues with participant objectivity, data fragmentation caused by inconsistent funding, data quality and accuracy (Whitelaw et al., 2003).

The focus of this paper is how the various activities conducted by stewardship groups relate to the complexities of *water governance*, which are distinct from the more commonly used term *water management*. While the two are often considered to be synonymous, the term management is typically used to address biophysical concerns only, whereas governance implies the socio-political and institutional systems and coordination activities involved in addressing a broad variety of water issues (Bodin, Ramirez-Sanchez, Ernstson, & Prell, 2011). Water governance is an emerging topic in environmental issues (Bakker & Cook, 2011) as it distinguishes, but doesn't separate, 'on-the-ground' activities from the institutions and decision-making processes.

Nova Scotia, Canada presents interesting examples of the interplay between stewardship and water governance. The province contains several large-scale, government-supported community-based programs, such as the Atlantic Coastal Action Program (ACAP), and many independent organizations, such as the Sackville Rivers Association[6], that have undertaken ad-hoc stewardship activities and in some cases have decades' worth of records and monitoring data (Cervoni, Biro, & Beazley, 2008; Conrad & Daoust, 2008; McNeil, Rousseau, & Hildebrand, 2006). Nova Scotia's provincial water strategy highlights the importance of "providing opportunities for groups and individuals to get involved in caring for water" (Nova Scotia Environment, 2010, p. 19), thus elevating the importance of water in broader public discourse. This paper seeks to provide a specific case of linking water stewardship, which is often associated with management-level activities, with water governance concepts.

[6] See: http://sackvillerivers.ns.ca/

4.4. Background

4.4.1. Conceptual Issues

Before delving into issues of water stewardship, it is important to understand the context in which these activities take place. In this section, five terms are introduced, which assist in framing conceptual issues in water stewardship activities: (1) governance, (2) management, (3) jurisdiction, (4) fragmentation, (5) community, and (6) social movements. *Water governance* refers to the people, processes, systems, institutions, organizations, and their interactions involving the administration of water, while *water management* refers to the various activities undertaken to regulate the physical properties water, such as movement, chemistry, and turbidity, water quality, as well as its human use and consumption (National Roundtable on the Environment and the Economy, 2011). The term water management, in referring specifically to tangible activities, doesn't necessarily encompass the multi-scale, multi-actor nature of water governance. Consequently, conflating governance with management results in a decreased ability to account for the inherent and complex human-nature interactions associated with water (Bodin et al., 2011).

A central concept of governance is *jurisdiction,* or 'who is responsible for what, and where'. Canada, as a decentralized federation, has a complex legal framework for defining jurisdiction, and contains a diverse set of water-related policies and legislation across different levels of government (Hill, Furlong, Bakker, & Cohen, 2008; Plummer & Arai, 2006). At each level of government, multiple departments and agencies are in some ways responsible for water and operate with relatively little coordination, some overlap, and occasional contradiction. This devolution of the overall responsibility of water to multiple institutions, departments, agencies, and levels is referred to as *fragmentation* (Bakker & Cook, 2011; Hill et al., 2008). In addition, in the context of governance and jurisdiction, the term *subsidiary*, refers to the 'downloading' of

responsibility from a parent governance unit, to a lower-level governance unit, or even outside agency or community group[7].

The term *community*[8] is also often used loosely and without a critical definition (Agrawal & Gibson, 1999; Kearney & Berkes, 2007). While defining community is essential to understanding the role that communities can have in governance, Cox, Arnold, & Tomás (2010) note that definitions should not be so rigid as to prevent institutional arrangements and external cooperation. The tendency to view communities as 'mythic', ideal, homogeneous, and static geographical units with similar societal interests and values has been supplanted in favour of a more 'interdependent' view. Inherent diversity, complexity, and in some instances, conflict in the individual and institutional interactions that encompass community are a constant reality of the term (Agrawal & Gibson, 1999; Berkes, 2004; Kearney & Berkes, 2007). While a precise definition of *community* is arguably context dependent, the term as applied in this paper includes references both to communities as geographically- or spatially-defined entities and communities of interest.

The definition of *Social Movement* is broad and can generally be defined as a distinct challenge to an existing structural social status quo (Meyer, Whittier, & Robnett, 2002). The stages of social movements – emergence, coalescence, bureaucratization, and decline – describe how people organize to respond to an issue of importance (Christiansen, 2009). In the emergence stage, an issue arises that generates broad discontent. In the coalescence stage, people begin to address the issue through clearer demands for change. The following bureaucratization stage is defined by a more formal organization and development of key roles and responsibilities. When a social movement declines, the movement has either succeeded at its intended purpose, failed,

[7] See for example: Hill et al. (2008)

[8] Wading into the scholarly debate about the richly contested concept of community is beyond the scope of this paper; however, readers may be interested in the following sources: Dalby and Mackenzie (1997), Godway and Finn (1994).

or been repressed or co-opted. In the context of this paper, environmental movements are included in the broad definition of social movements.

4.4.2. Community Participation in Environmental Issues

Broad participation through stewardship is encouraged by both decision-makers and other interested parties to facilitate ongoing citizen engagement in various issues. However, a major challenge to public participation is that the various engagement mechanisms and processes must constantly evolve and change to address unique issues (Irvin & Stansbury, 2004; Perkins, 2011; Turnhout, Bommel, & Aarts, 2010). Important considerations in public participation are 'who participates', whether they are the 'right' people to make informed and reasonable contributions to environmental decision-making, and the often unequal power dynamics of public participation (Irvin & Stansbury, 2004; Perkins, 2011; Turnhout et al., 2010). An increasing trend in environmental decision-making is to address these considerations through the use of citizen science programs (Dickinson et al., 2012). Stewardship programs, as a form of public participation in environmental issues, usually incorporate some form of monitoring activity (Conrad & Daoust, 2008). Through publicly available, participatory, scientific research, individual community members are able to acquire interest and expertise in environmental issues, while at the same time a power balance is restored as 'experts' are able to coordinate with on-the-ground community scientists (Shirk et al., 2012).

Often, stewardship occurs as a result of real or perceived threats to the environment, and/or in instances where trust in public and private institutions to adequately monitor and respond to community concerns has failed (Bliss et al., 2001). Examples of perceived failures in an institution's ability to respond to community concerns are numerous and can include government cutbacks to monitoring and environmental programs, or inadequate industrial or

commercial monitoring (Roach & Walker, 2017)[9]. One Canadian example of a response to these concerns was the development of the Ecological Monitoring and Assessment Network (EMAN) in 1994, which coordinated government, academia, industry and community monitoring efforts (Vaughan, Brydges, Fenech, & Lumb, 2001)[10]. There are also instances where community groups have chosen to conduct environmental stewardship activities and monitoring for other reasons, such as to learn about scientific processes such as data collection and rigour (Cuthill, 2000).

In many stewardship cases, monitoring activities are conducted by unpaid volunteers, which often creates other challenges such as disinterest and burnout (Byron & Curtis, 2002). The major criticisms of stewardship are centered on issues of capacity and credibility of 'non-experts' (Bradshaw, 2003; Whitelaw et al., 2003). Examples that have been highlighted include lack of volunteer interest, perceptions of bias in volunteers, and inadequate training and funding (Bliss et al., 2001; Stadel & Nelson, 1995; Whitelaw et al., 2003). Conrad and Hilchey (2011) identify that these challenges stem from issues of group organization, data collection, and data use as without the proper supports in place, groups are unable to sustain long-term programs. However, Shelton (2013) demonstrates that when 'non-expert' volunteers are trained appropriately, their data and results can be comparable to those collected by 'professional' scientists. Thus, some criticisms may not have a sound basis, and while others may be legitimate, they are being examined and addressed through ongoing scientific research.

4.4.3. Study Context: Nova Scotia, Canada

The Province of Nova Scotia is situated in eastern Canada. Nova Scotia directly borders only one other province - New Brunswick, and no international borders are shared with this part of Canada. The population of Nova Scotia is approximately 920,000 people. Most (65%) of the

[9] Roach and Walker (2017) highlight several current inconsistencies in how water quality monitoring is conducted across Canada and notably before and after major changes to Canadian environmental assessment processes in 2012.
[10] Funding for EMAN was suspended by the federal government in 2010.

population is located in or near populated census metropolitan areas or census agglomerations[11], with a substantial population (390,000 people) located near the capital city and administrative centre, Halifax (Statistics Canada, 2011b). Canada is a decentralized federation with multiple levels of government. As a province in Canada, Nova Scotia has a provincial government, which is distinct from the federal Government of Canada. In addition, there are two Regional Municipalities and 16 Counties with their own municipal governance structures. Indigenous peoples in the region have somewhat autonomous governance systems. Each level of government also contains several departments and agencies (see for example Table 9).

Table 9: Examples of government departments and agencies that have a responsibility for water in Canada

		Department/Agency					
Level of Government	**Federal**	Fisheries and Oceans	Environment and Climate Change	Transport	Foreign Affairs	Indigenous Affairs	Agriculture and Agri-food
	Provincial	Natural Resources	Environment	Health	Business, Commerce		
	Municipal	Drinking Water	Waste Water	Parks and Recreation			
	Other	Indigenous Governments	NGOs				

In most of Canada, boundaries for federal, provincial, and municipal governance systems have not generally been constructed to incorporate the natural features and properties of water (Cohen & Davidson, 2011). Because Nova Scotia is nearly an island, the discontinuity between governance and water-feature boundaries is most pronounced at the regional municipality and

[11] Statistics Canada defines a Census Metropolitan Area (CMA) and Census Agglomerations as "consisting of one or more neighbouring municipalities situated around a core. A census metropolitan area must have a total population of at least 100,000 of which 50,000 or more live in the core. A census agglomeration must have a core population of at least 10,000." (Statistics Canada, 2011a, p. 90)

county level (Figure 2). Moreover, the responsibilities for governing water in Canada, for purposes such as drinking water, fisheries, recreation and groundwater, are delegated to various levels of federal, provincial, municipal and Indigenous governments, creating jurisdictional fragmentation and overlap.

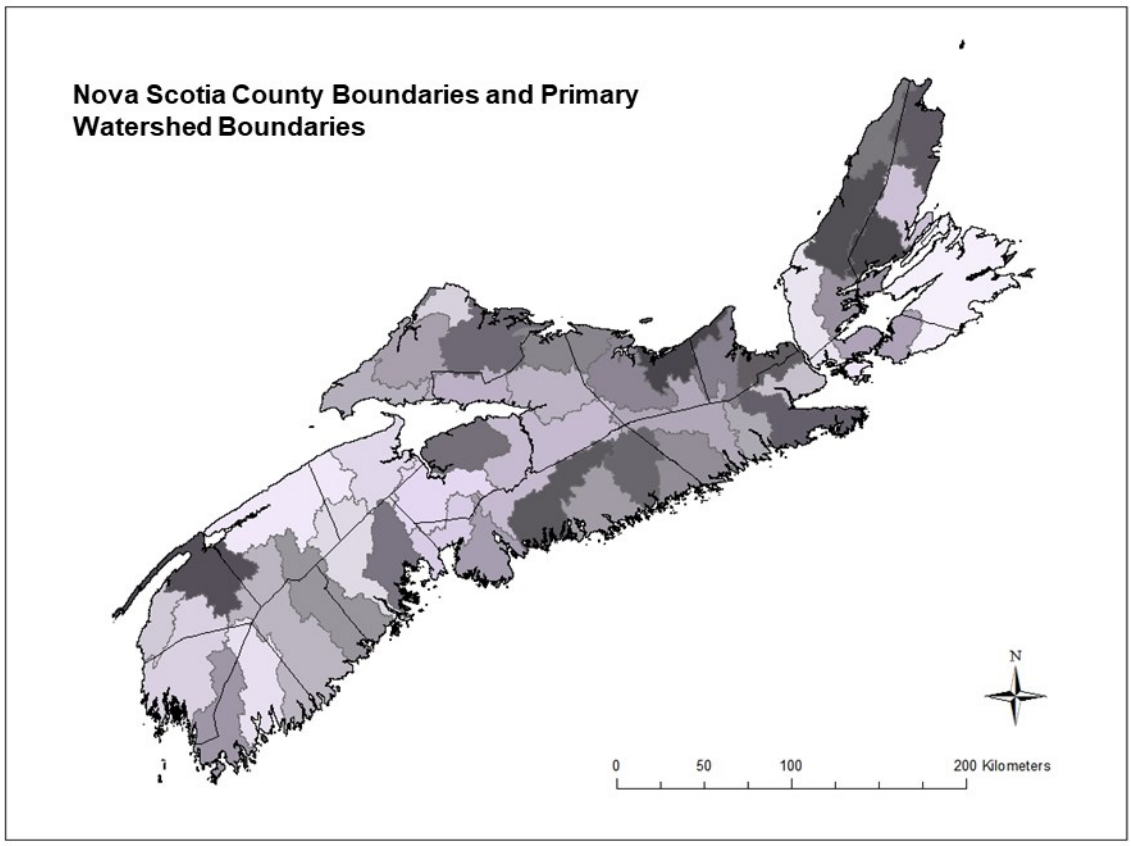

Figure 2: Nova Scotia County Boundaries and Primary Watershed Boundaries

In 2010, the Nova Scotia Department of the Environment released Nova Scotia's water strategy, entitled *Water for Life.* This ten-year strategy highlights three key objectives under the umbrella goal of 'integrated water management': 1) understand the quality and quantity of water; 2) protect the quality and quantity of water; and, 3) engage in caring for water (Nova Scotia Environment, 2010). Although the strategy is identified as a management strategy, it does serve

some governance functions, such as addressing issues of jurisdictional fragmentation and community involvement. Since its release in 2010, two progress reports have highlighted progressions and actions that have been undertaken, including the establishment of water advisory groups, assessment frameworks, programs, workshops and training (Nova Scotia Environment, 2012, 2014).

There are numerous community-based stewardship groups that are integral to Nova Scotia's water strategy; in many cases these groups (e.g. the Sackville Rivers Association, Shubenacadie Watershed Environmental Protection Society, and the Clean Annapolis River Project) have well-established water-monitoring and data-collection programs, and in some cases have decades-worth of information (Cliche & Freeman, 2016; Conrad & Daoust, 2008; Guehlstorf & Hallstrom, 2012; McNeil et al., 2006). Groups are located in various regions of the province, in both urban and rural settings, and participate in a number of different activities that *Water for Life* identifies. The timing of *Water for Life* also overlapped with a 5-year research project examining water stewardship in Nova Scotia (CURAH20.com).

4.5. Methods

Primary data collection was conducted from September 2013 to March 2014. Semi-structured telephone interviews were conducted with nine key informants who were recruited because of their roles in water stewardship organizations. These individuals had responded to a survey on water stewardship issues and were asked if they (or someone from their organization) would be interested in participating in a follow-up interview. While the data collection and analysis processes are described in a linear fashion for clarity, in practice the process was highly iterative and reflexive. Questions were only loosely structured, and the topics of conversations changed at the discretion of the interviewees.

Table 10: Summary of Interview Respondents

Informant	Role of Informant in Stewardship Group	Number of Years Group has been Established
IN1	*Senior Volunteer*	30+
IN2	*Senior Volunteer*	0-4
IN3	*Manager/Director/Coordinator/President/Chairperson*	15-19
IN4	*Manager/Director/Coordinator/President/Chairperson*	20-24
IN5	*Manager/Director/Coordinator/President/Chairperson*	25-29
IN6	*Staff Member*	25-29
IN7	*Staff Member*	20-24
IN8	*Board Member*	15-19
IN9	*Manager/Director/Coordinator/President/Chairperson*	5-9

An interview guide was used to direct semi-structured conversations with participants. The interview guide followed a funneling structure, which first used generic, overview questions designed to build rapport with participants, followed by primary and secondary questions related to the theme of the study (Dunn, 2005) (Appendix X). Interviews were audio-recorded and transcribed verbatim, and participants received an opportunity to review their transcriptions and were encouraged to make revisions and provide comments. Of the 9 participants, 3 made minor changes and corrections. Using qualitative data management software (*Nvivo10*), data were subjected to thematic analysis using a combined deductive/inductive coding approach (Fereday & Muir-Cochrane, 2006). Initial rounds of coding began with a list of pre-determined – or primary – codes, derived from various communications with participants and scans of academic literature (Table 9). Subsequent rounds of coding revealed additional data-driven – or secondary – codes (Table 10), which were added to the codebook as they emerged throughout the coding process.

Table 11: List of pre-determined – or primary – interview codes

CODE NAME	DESCRIPTION
Activity	*The things that an organization does*
Capacity	*The ability of an organization to conduct activities*
Demographics	*Characteristics of participants involved in the organization*
Development	*Reference to a particular development (i.e.: construction, housing, etc...)*
Organization Lifespan	*How long the organization has existed*
Students	*Any reference to students*
Water Governance and Jurisdiction	*Reference to decision-making processes, institutions*
Youth Engagement	*Engagement with young people*

Table 12: List of data-driven - or secondary - interview codes

CODE NAME	DESCRIPTION
Advisory Council Members	*Description of an advisory group, committee, etc.*
Communication	*Interaction of some sort with other organizations or the general public*
Conciliation	*Mitigation of conflict or distrust*
Engagement Approaches	*Ways that organizations relate to or engage with the public or other organizations/institutions*
Formation Challenge	*Challenges of organization formation*
Formation Story	*Description of how the organization was formed*
Funding	*References to funding*
Issue or Event	*Reference to a specific environmental incident or environmental incidents*
Organization-developed Tool or Product	*Tool/product that an organization itself has developed*
Other Challenges	*Challenges that may not necessarily fit into other categories*
Project Leadership	*Actions that are led by an organization itself*
Reasons and Rationale	*Justification for why organizations conduct activities*
Success Story	*A particular accomplishment of an organization*

Coded data from interviews were subsequently combined and organized using queries. The results were then merged into themes that highlight perspectives on stewardship programs in Nova Scotia and provide new insights into stewardship groups in Nova Scotia and their relationships to water governance.

4.6. Findings

Five key themes were elicited where participants described their experiences in community stewardship. These themes describe the triggers and catalysts to stewardship and the process of group formation, the activities groups conduct, how stewardship groups perceive success, and ongoing limitations and challenges of their stewardship groups.

4.6.1. "People were mad as hell": Triggering Incidents in Group Formation

Community participation in environmental issues occurs when there is both a will and the means to undertake the environmental activities that need to be accomplished (Bliss et al., 2001). In the context of this study, an environmental incident or event prompted the formation of stewardship groups, primarily to undertake specific activities.

> *[Our group] was organized in 1986, following a mine tailings pond blowout, which introduced an unacceptable level of turbidity into the [the river]. (IN5 – Mark, Pers. Comm.)*

> *[We] really sprung up in response to the mine being expanded into the Peninsula, which to the west of the ferry road is known to contain the highest flora biodiversity in a [specific] environment anywhere in eastern Canada. (IN9 – Luke)*

These triggering incidents acted as catalysts for volunteer activity within the geographic regions in which they occurred. The incidents, perceived as detrimental to the environment, stimulated community members to organize and advocate for environmental issues. While incidents

themselves triggered initial environmental engagement, subsequent events in the same geographic area continued to motivate individuals into performing some sort of action.

> *Some smartass came along and built [something] in a barachois*[12]*. Someone filled in one of these, and we reported him, and they were made to pay a fine of $10,000. And they gave us $3000. I mean, that was several years ago, but that kind of was a good thing to do because it set a precedent. So, thereafter, I don't think any barachois have been filled in, yet. To dig it out and fill the whole thing, it would cost them a stack. (IN8 – Edward)*

> *There were some concerns at the lake regarding bacteriological issues, e-coli in particular. Concentrations shut down the lake for public recreational use and because of that issue, the community group started forming to look into the cause. There was suspect that a recent upgrade to a sewage pumping station at the end of the lake may have been associated with the bacteriological issue in the lake. So, that's how the group started and from there we formalized the group. (IN2 – Alan)*

4.6.2. "We put our boots on": Activities of Stewardship groups

Participants elicited different ways that stewardship groups take part in functions of governance. Distinguishing between management activities and governance activities becomes challenging with participant characterizations of activities as many include a dual role for stewardship. The two activities that are highlighted here are 'Information Gathering' – stewardship's role in data collection, and 'coordinating people' – how stewardship groups involve people in water issues.

[12] A barachois is a body of salt water adjacent to the ocean, separated by a sand or shingle bar. The term is used widely in Atlantic Canada.

4.6.2.1. Information Gathering

Participants referred to the importance of gathering information as part of their activities. An example is in the collection of water quality data through monitoring programs.

> *Well they started the data collecting in late 2007. So, since then, water quality monitoring occurs bi-weekly. And then, once a month, we take grab samples, and we take two maximum for analysis. So, of course, with that, we have quite a bit of data. (IN7 – Leah)*

> *[The government] had water quality sampling program, and they've actually cancelled that program. So, we've picked up on that, and we're trying to continue on, so that we have continuous data, so we can identify trends. (IN2 – Alan)*

In addition, to data collection, information gathering also referred to harnessing community awareness and public opinion on an issue related to water.

> *If they see silt running in the river, they know it's coming from developments or they see the developer cutting right out to the river and not honouring, or not leaving a buffer, they will call the province, they will call the municipality and nothing happens. So purely out of frustration, they'll come to us. I think that's the biggest thing is "I can't go to the government, they don't listen to me. I'll go to you, I know you will listen to me." (IN6 – Derryl)*

Community-based water monitoring programs play a fundamental role in the collection and analysis of information (T. Sharpe, Savan, & Amott, 2000). While monitoring in and of itself can be viewed as a management activity, the information gathered through water quality monitoring can inform decision-making processes in water governance.

4.6.2.2. Coordinating People

In addition to monitoring, participants identified the role of stewardship organizations in engaging members of the general public, and coordinating activities that relate to water management and governance in the three examples below.

> *So, we organized a bio-blitz and... combed these areas that were slated for, basically, the blade of the bulldozer and the bad end of the fuse of dynamite. And, we proceeded to discover more and more things that were missed in this area during the EA [Environmental Assessment] process. (IN9 – Luke)*

> *In the fall, there's Nova Scotia Department of Fisheries and Aquaculture, they come down here and they collect salmon. They call it brood stock – which is the stock they use to hatch the eggs from. Then they put them back in the river once the eggs hatch. And our little group will get together and help them with it. I guess what you would call an 'in-kind' contribution. We get quite involved. We put our boots on to get out in the water and help them gather the fish up. That's one thing we're involved in, in terms of actual physical labour. (IN4 – Peter)*

> *We also provide education opportunities to the community, as well through educational programs: one is Fish Friends, the other one is River Rangers. We provide support to other river restoration groups, as well; and we also lobby for environmental issues in within our community. (IN6 – Derryl)*

4.6.3. "We elected a board on the spot": Growth and Organization

While specific environmental incidents motivate people, interview respondents noted the importance of key actions in developing an organizational structure to conduct activities related to these events. The development of an organizational entity – whether forming a formal,

incorporated society, or a loosely affiliated board – was identified as an important step in the process of undertaking water stewardship activities, as evidenced below.

> *There was a movement around the lakes to stop things happening in the lake without anyone paying attention. There was a roundtable that came out with a report, almost as sort of a plan or a campaign suggesting – and I think it went far too far, really – but they wanted almost like a separate state or a separate parliament: a ruling body around the lakes. It was shut down by the minister at the time and it was pretty inevitable that it would be. But still, a lot of good points came up. So, we elected a board on the spot at this first meeting and we were quite active, with fairly regular meetings as a board, and we had a very good chairman. And he would just pick things out of the blue when we were there at the meetings. He was a fantastic chairman, very well known in government. He worked for various industries and so on. So he was very well known and he was very enthusiastic about this […] and we were quite active in those early days. (IN8 – Edward)*

Interview respondents also noted the importance of community development, whether knowledge sharing among certain individuals, or having recreational programs in a specific area, as a reason to form a specific organization dedicated to monitoring not just water but environmental issues in general.

> *It started in the 1970s and it's an organization that was concerned with anything to do with the community in the area. Our lake is a lake which has a long, rich history of land use and community, and so it was not a group focused on the water quality and the lake so much as the community. But the sustainable development subcommittee that just formed in 2011 was formed to keep local and seasonal residents informed about issues and best practices concerning land use and development. (IN1 – Sarah)*

4.6.4. "If we hadn't pushed them, they wouldn't have done it": Perceptions of Success

Interview respondents were also keen to share stories of what they considered successful components to stewardship. Three forms of success emerged in interviews: (1) success related to environmental activities of the stewardship group, (2) an outcome was achieved, and (3) generating recognition from the broader community.

4.6.4.1. Social and Environmental Activities

Respondents identified the importance of undertaking some sort of tangible on-the-ground activity as a form of community stewardship. These activities were viewed as important events that engaged members of the broader community as well as had an impact on the overall quality of the environment even if they were not directly related to water quality and quantity issues.

> *Either we do a rock throwing event, which is, of course, moving rocks around within the river to increase flow patterns, dig the depth of pools on the bottom of our structures, [or] we also do regular clean ups as well throughout the community all along the river. Sometimes it's not just necessarily for volunteers in the community; we also do cleanups, in addition, for companies that want to be able to have their employees come out. (IN6 – Derryl)*

> *Another event we have every year is called a Freecycle. People up in Sydney started this three or four years ago. One of our members thought we should have it down here. So, there's a church hall here – it's a very large facility with a community auditorium – so we just let everybody know, from 8am till 9am, bring in your used, workable electronic equipment and then from 9am to 10am anyone that wants to pick up free electronic equipment can come and pick it up. That works really well. And what I like about it is that they keep perfectly usable electronic equipment out of the recyclers, because all*

they do is throw it in the bin and it gets taken apart - or some are chemically taken apart - for their components. (IN5 – Mark)

While providing an ecological and environmental benefit, these activities were primarily viewed as social activities. Interviewees referred to events where individuals gathered to perform environmental activities in conjunction with other events where the focus of the activity also had a social purpose, such as bringing community members together.

4.6.4.2. Achieving Desired Outcomes

Regarding activities community stewardship groups performed, interview respondents identified outcomes that translated to a perceived benefit to water management. What the benefit entailed was context dependent, but included the construction of new water infrastructure, or the halting of some sort of detrimental activity.

We pressured the town into producing a new sewage system. The other system just emptied all the sewage straight into the lake. I reckon we weren't the only ones, but we were the ones who pressured them to do it. I mean the town is very reluctant to admit that we did pressure them, but a warden of another county said to us at a meeting that, 'if you hadn't pushed them, they wouldn't have done it'. You know another thing: once one place gets a good sewage system, then other places have to look for them, too. (IN8 – Edward)

And, the Municipality down here just recently passed a by-law of no construction within 40 feet of a lake or river and minimal development. This is a change. I mean, some people have wider setbacks […] but they don't prescribe what people should do in there; and it's only 40 feet, but minimal disturbance, which is good. (IN5 – Mark)

The desired outcomes that interviewees referred to were generally an environment-oriented outcome achieved through a combination of sustained monitoring and

political pressuring of decision-makers – usually a level of government, but in some cases, another organization or institution.

4.6.4.3. Community Recognition, Validation and Awareness

Stewardship programs were seen to be important both within and outside the geographic communities they serve. In instances where interviewees defined recognition and validation as a form of success, they were able to highlight specific instances where members of the broader community or public figures are engaged with environmental issues.

> *There's a real awareness around the lake, by people, of the importance of keeping the quality of the lake healthy. So, people notice things. They're watching and they live there all the time. They have … continuous long-term observations of the lake and they know what's going on and are concerned. So, I think that from a grassroots perspective, there's lots of knowledge and lots of interest. (IN1 – Sarah)*

> *So, where it is now, we've got a fairly comprehensive website, fairly decent water quality sampling program considering it's all volunteer based, developed some pretty good partnerships, received some contributions and acknowledgements from MPs [Members of Parliament], MLAs [Members of the Legislative Assembly] and councillors, a few award nominations, just got a recognition in the legislature for our group, and we have approximately 85-90 households that are members. I think it went up about ten households this year. (IN2 – Alan)*

In addition, there is a long-term benefit to having a recognized community stewardship group within a local geographic area. Community members recognize the group and are able to communicate concerns to other governance entities.

We are a very vocal group in the area. Any time development goes on, they know that we usually get a heads up in advance, usually as a courtesy from either the developer or the municipality, to let us know that something is about to happen, because they know that we are going to be yelling and screaming about it if there's any kind of negative impact. So, knowing that, we tend to have a little bit more information on the developments, and knowing that, we will often speak out about it. I wouldn't say that the government necessarily listens to us, but at least they take notice. (IN6 – Derryl)

In these cases, success was viewed as part of the continuing relationship between the various communities and organizations that take part in addressing water and environmental issues.

4.6.5. "Trying to get anything changed is extremely difficult": Ongoing Challenges

Participants described several challenges that stewardship groups encounter when undertaking activities. The challenges described were often unique to the operational characteristics and circumstances of each stewardship group, but together revealed broader issues that stewardship groups encounter. These revolve around jurisdictional boundaries, competing agencies, and divestiture of responsibility, and challenges in sustaining a volunteer organization.

4.6.5.1. Jurisdictional Boundaries, Competing Agencies, and Divestiture of Responsibility

Interview participants were able to elaborate that their activities typically fall within a jurisdictional 'grey area', when coordinating with government departments or agencies, or when planning to conduct activities.

One of the problems about the lakes, for instance, is that something like 22 different agencies have a say in it: 22 different government agencies. So you have Lands and Forests, you have Department of Environment, you have

county councils, you have First Nations, and on and on. And they're interwoven. Trying to get anything changed is extremely difficult. (IN8 – Edward)

No one quite knows where the enforcement of regulations is going. It always was a joint effort of Nova Scotia Department of the Environment and the federal DFO [Department of Fisheries and Oceans], but nobody seems to know who's going to – and these are government agencies for that matter – seem to know where this is going. So, some of our members – one in particular – has been writing a lot of letters trying to find out, if he wanted to do something, who he'd have to get permission from. It all seems to be very obscure at the moment. (IN4 – Peter)

In some cases, participants attributed organizational challenges to the complex nature of working with multiple layers of government. Participants noted that jurisdictional fragmentation is of concern to stewardship organizations because different priorities at different levels of government can affect laws, regulations, programs and funding that apply to them.

Because they're usually wearing two hats: one hat, where you have Department of Environment, Protected Areas Branch; and then, you have Department of Natural Resources, which is also wearing two hats, because they say, well, we have a department that looks at species at risk and conservation of flora and fauna, but then you have another branch within the department, that is the mining branch, that is for the promotion and extraction of natural resources. (IN9 – Luke)

Under the Department of Natural Resources [DNR], if you find that someone has broken the rules, you have two years; that is, you have up to two years ago; it's the statute of limitations. Even if it goes back to one year and 363 days, you can still be prosecuted for it, if they get you in time, if they get to

you in time. The Department of the Environment is only six months. And we were trying to get them to say, well look, this is ridiculous. The Department of the Environment and the DNR: if you're at the edge of the lake and you move one inch further away from the lake from a certain point, you're under the DNR, or the other way around and the Department of the Environment takes over. I mean, they're so closely allied; it's ridiculous that they don't have the same rules, but they don't. (IN8 – Edward)

Yet despite the jurisdictional fragmentation challenges, interviewees noted that stewardship groups still undertake activities that would otherwise be the responsibility of a government agency or department. Whether a management activity, such as restorative work and monitoring, or a governance function, such as coordinating other groups, or communicating with community members, these activities, which may have at one point been conducted by one or more government agencies or departments, are now perceived to be community- or stewardship-group led.

4.6.5.2. Limits, Lifespans, and Externalities

Interviewees referred to the various challenges of working with volunteers. These challenges, relate to difficulties of recruitment and retention of individuals with an interest in environmental stewardship.

I want to say this about voluntary societies: I think they have a lifespan. They're started by some group of people: enthusiastic, they do all the work, and so on. And, you know, most of us are on pensions and so on; we've got the time, I suppose, relatively speaking. And, the truth be known, you look at the board, we're relatively well off. We don't have to worry too much about money. Young people have to earn a living, doing this or doing that. [This] is not the place to make a fortune, really. So, they work bloody hard, these people, to earn a living and to do this kind of voluntary work as well. The vast majority of people don't do it. (IN8 – Edward)

> *People your age* [young adult] *are gone. I mean, they are not here. Most of them have decided not to go to university. They go to community colleges. They get to be pipe fitters or welders, and the first thing, they're on the airplane to Fort McMurray. You know, they just make obscene money and they're certainly not going to stay around here for $11 an hour for department of highways work. They're just not going to do it. (IN4 – Peter)*

One interviewee noted that his organization, which has been well established, still has difficulty finding people who are interested in their activities. The interviewee also noted that there are challenges for anyone who tries to form a new organization, that without the support and resources of an existing group, it can be difficult to organize and undertake environmental activities.

> *So, I mean, even for an organization like ours, that's been around for 25 years and has... and has had pretty strong ties to the community, it's still hard to find people. So, I mean, if you don't have already some sort of established community group, river group, watershed group it would be very difficult to pull people into that. That would be part of the problem - is trying to get enough people to actually be on there. Like I said, we have enough problems as it is and we've been around for quite a while, let alone trying to get something going from nothing. (IN6 – Derryl)*

4.7. Discussion

Results of this study detail roles of community-based water stewardship groups in the context of water governance. Community stewardship groups' abilities to traverse governance boundaries, such as municipal borders, in turn lead to localized environmental outcomes. The ability of stewardship groups to undertake activities that span across governance boundaries depends on a multitude of factors, including the progression of stewardship groups through the various stages of social movements. The perspectives of the individuals captured in this study detail the

various events that trigger the initial formation and subsequent activities of stewardship groups as they navigate the various stages of forming and legitimizing an organization. The successes and ongoing challenges, which participants defined themselves, that groups face as they continue monitoring, restoring, educating, and other environmental activities are largely dependent on whether a group is able to navigate both the intricacies of social movements and the complexities of water governance.

4.7.1. Stewardship as a form of Social Movement

Recruitment and retention were highlighted as a barrier to undertaking long-term stewardship activities. Recruitment tended to occur early in the lifespan of an organization in response to the roused sentiments around triggering events. Such roused sentiments in turn generate community organization and action and may experience a decline over time. This experience is consistent with past studies regarding participant retention in water stewardship groups (Guehlstorf & Hallstrom, 2012; Irvin & Stansbury, 2004; Lee, 2005). It is also not unique to stewardship groups or environmental issues, but rather reflect an established framework around social movements and social change organizations in general (Christiansen, 2009). The stages of social movements – emergence, coalescence, bureaucratization, and decline – closely resemble the formation, organization and limited lifespan of community stewardship groups as described by the participants in this study. While the contexts in which they operate differ, there are similarities in the ways that social movements and community stewardship groups develop. The similarities create opportunities to understand the overall role of social change in community stewardship groups and warrant further exploration in their applicability to water governance.

The ‘emergence’ stage occurs when a community takes notice of an environmental issue and seeks to respond in some way. It can be a sudden event, or in some cases a long-term degradation or change. In the ‘coalescence’ stage, individuals who are concerned about water quality organize into a much more formal group and develop capacity to undertake activities, such as water quality monitoring, clean ups, and public awareness campaigns. This stage also represents a period when participants actively learn and seek out individuals who may have

some expertise in environmental issues. The 'bureaucratization' stage describes periods where stewardship groups undertake more official organizing, such as registering an organization, and adopting internal by-laws policies and procedures. In addition, groups may choose to hire staff members. When groups are in 'decline', they experience a period of either overall success, or incapacitating challenges. At this point of decline, stewardship groups may formally or informally dissolve.

Participants in this study revealed that there are several factors that contribute to each of the four stages of social movements in the context of stewardship groups. Triggering incidents, as described by interviewees, highlighted the role of specific events in shaping community perception and reaction to environmental issues during the emergence stage. Similarly, the mobilization of interested individuals into volunteers for a particular environmental action is dependent on a stewardship group's ability to organize, whether formally or informally during the 'coalescence' stage. These activities then become more regular and coincide with other efforts to make an organization more legitimate during the 'bureaucratizing' stage. Externalities, such as the population decline described by interviewees, or the overall success of the group, determine whether stewardship declines in certain communities. It should be noted that these stages are not siloed and should not be presented as 'boxed' or a constraint, but rather community stewardship should be viewed as dynamic, given the important involvement of volunteers.

4.7.2. Implications for Water Governance in Nova Scotia

Participants reinforced the role of stewardship in addressing either real or perceived threats to the environment, consistent with Bliss et al. (2001) and readily highlighted the role of stewardship in undertaking management activities related to water (a role that has received much attention and is generally well understood). However, their views on stewardships' direct involvement in governance was less clear. Notably, two examples were identified where stewardship could address existing challenges in water governance: information gathering and activity coordination. When conducted by community environmental stewardship groups, these activities can transcend traditional challenges of water governance, namely the devolution and

divestiture of overall water responsibility and jurisdictional fragmentation between various governance authorities, consistent with Hill et al (2008).

Information gathering by community stewardship groups can transcend devolution and divestiture of overall water responsibility and jurisdictional fragmentation because they are not constrained by entrenched mandates or historical jurisdictional or geographical boundaries of government agencies. The information gathering process encompasses the many was in which stewardship groups 'keep watch' over a geographic region, defined by the natural value or environmental issue of interest. Such activities in Nova Scotia can range from visual observations to conducting rigorous scientific data collection programs, to addressing concerns from community members. Information gathering by stewardship groups becomes useful where traditional governance entities, for example a government department, are not able to gather adequate or appropriate water information, either because of fragmentation, devolution, or a lack of resources, as described by some groups in this study. Consistent with Cohen (2012), in Nova Scotia this is prevalent where municipal and provincial boundaries do not necessarily align with water bodies or boundary objects – namely watershed boundaries – and consequently the overall responsibility for water is unclear. Stewardship groups are able to provide information and liaise with more traditional governance entities (e.g.: departments and agencies at various levels of government) in order to achieve desired environmental outcomes across jurisdictions and geographies.

Activity coordination by community stewardship groups can transcend devolution and divestiture of overall water responsibility and jurisdictional fragmentation because stewardship groups can connect with individuals who reside outside a geographic jurisdictional area or outside a particular boundary. In the activity coordination role, stewardship groups can coordinate water management activities - such as cleanups and restorations – with paid staff members and/or volunteers. These activities can traverse governance boundaries which may not align with environmental or water boundaries. Stewardship groups are also able to generate a broader public awareness of water issues by using traditional forms of media, and by building

relationships with key individuals – a process described by Cuthill (2000) and Perkins (2011). As divestiture and devolution of environmental responsibility constantly change the landscape of water governance, stewardship groups can provide a consistent presence in the processes of decision-making around water when adequately resourced.

4.8. Conclusions

While this study captures perspectives of nine individuals who are active in stewardship groups in Nova Scotia, it may be limited in terms of broad generalizability. Nonetheless, the key findings of this study – the role of triggering incidents in group formation, factors affecting growth of organization of stewardship groups, how stewardship groups perceive success, and the ongoing challenges of stewardship - reveal that stewardship groups have the ability to, in the right circumstances, provide critical functions related to water and environmental governance, namely the gathering of information, and coordinating environmental activities. These findings have implications for both individuals who shape water policy (e.g., government officials, academics, business leaders, community leaders) and individuals involved in stewardship themselves. While generally considered water management activities, the processes of forming an organization, providing information to decision-makers and engaging the broader public in water issues are also significant functions of water governance. However, ongoing challenges to stewardship – including navigating jurisdictional boundaries around water and maintaining long-term viability and adaptability of stewardship programs over time – provide a direction for future research.

CHAPTER 5: CONCLUSION

5.1. Chapter Introduction

In this chapter, I link the main findings from the various analyses to my research goal and objectives, thus providing their synthesis as a coordinated program of research. I briefly summarize the key findings of the study, discuss the theoretical, methodological, and substantive contributions; strengths and limitations; and conclude with potential directions for future research.

5.2. Review of Research Goals and Objectives

The goal of this study was to determine the potential roles for and influence of community-based water stewardship groups in Nova Scotia, Canada. The rationale for choosing this as the primary research goal was to understand stewardship within the much broader conceptual topics of human-environmental interactions and water governance. To achieve the goal, there were two main objectives:

1. Identify the roles of Nova Scotia water stewardship groups in the context of Social-Ecological Systems, and
2. Determine how individuals involved in stewardship view their roles in water governance.

With regard to Research Objective 1, SES thinking is based on linking human issues with environmental issues (Ban et al., 2013). With regard to Research Objective 2, water governance refers to the various decision-making organizations and the processes they follow (National Roundtable on the Environment and the Economy, 2011). These research objectives were achieved through a phased qualitative study approach. In Phase 1 of the study, an initial survey was sent to community stewardship organization managers, staff members, volunteers, and directors to elicit their views on how their organizations are connected and what 'connections' mean to their organizations. In Phase 2 of the study, respondents of the survey participated in a

follow-up, in-depth, semi-structured interview session to elaborate further on their perspectives on water stewardship and the links between their activities and the decision-making processes of water governance. Survey and interview transcripts were transcribed and analyzed through multiple rounds of thematic coding using both 'deductive' and 'inductive' approaches and NVivo qualitative data analysis software. The Results were then synthesized into findings that relate to the objectives of this research project.

5.3. Summary of Main Findings

5.3.1. Objective 1: Identify the Roles of Nova Scotia Water Stewardship Groups in the Context of Social-Ecological Systems

In relation to research objective 1, two key findings emerged: (1) the role of stewardship groups as an actor between governance systems, interactions and users in the context of SES; and, (2) how this role is operationalized as a stewardship domain through the specific *events, activities,* and *areas of practice* that stewardship groups conduct. Participants of this study were able to describe the role of stewardship as a way of engaging in governance, user-group, and environmental issues as part of a SES. While not explicitly stated by participants in interviews, the underlying sentiments of participants suggest that stewardship is viewed as a form of interaction between the users, or user groups and the governance systems and entities involved and that these organizations operate through a series of tasks – or *events*. In turn, organizations then operate several of these events into broader categories of *activities.* These events and activities fall under a specific domain – or *area of practice* – that stewardship groups operate within.

Of importance, however, was the distinction between 'stewardship groups' and other 'user groups' and 'non-governmental organizations'. In the context of an SES, this purposeful distinction on the part of participants highlights how individuals involved in stewardship distinguish themselves from 'users' and 'consumers' of a resource – in this case water. The positioning of stewardship groups as an actor between resource users and governance systems allows stewardship groups to maintain a unique focus on environmental goals and outcomes,

which may not necessarily be replicated by other aspects of the 'governance systems' (including non-government organizations) or 'users' variables of the SES framework.

5.3.2. Objective 2: Determine How Individuals Involved in Stewardship View Their Roles in Water Governance

In relation to research objective 2, three key findings emerged: (1) there is an important role in 'triggering incidents' as a driver of stewardship group formation and subsequently how stewardship groups respond to sudden environmental issues: (2) there are challenges with maintaining ongoing, long-term involvement in water governance activities; and, (3) there are concerns with long-term organizational sustainability. These findings represent the diverse views of individuals who participate in the deliberative and decision-making processes involved in addressing Nova Scotia water issues.

Regarding triggering incidents, groups are initially formed in reaction to a specific event that triggers the mobilization of a community. Many such incidents take place quickly and traumatically – such as a spill, or pollution – or cumulatively over time – such as in the case of long-term development. These incidents spur community groups to organize and take part in not just the management of water but the institutional processes of decision-making and working with other entities to achieve stewardship goals and objectives, or the 'governance' issues of water. However, while the events of triggering incidents are useful in driving initial interest in organization formation, they are often not enough to sustain long-term interest in water issues. Despite the initial community engagement, stewardship groups must cope with declining interest over time, the resource intensive processes of forming an organization, and the long-term processes of sustaining it.

These findings suggest that individuals involved in stewardship view their role as primarily external to the broader issues of water governance. While the definition of water governance is intended to refer to the people, processes, systems, institutions, organizations, and their interactions involving the administration of water (Bakker, 2007; National Roundtable on the Environment and the Economy, 2011), the findings of this study suggests that the close link to

specific event-based water issues, coupled with the challenges of maintaining ongoing interest and organizational sustainability require that individuals involved in stewardship organizations participate more in water management – that is the 'on the ground' activity (Bakker, 2007; National Roundtable on the Environment and the Economy, 2011) – despite the intention of stewardship groups to be actively involved in water governance. These findings also suggest a need to further examine the context for stewardship and whether there are needs and opportunities to sustain ongoing community involvement in water governance through stewardship organizations.

5.4. Study Contributions

5.4.1. Theoretical Contributions

This research contributes to the scholarly field of SES. The study conducted as part of this research examined how stewardship interacts with the components of a Social-Ecological System, namely in the context of the variables outlined in Ostrom's (2009) framework for analysing the sustainability of such a system. The results of the study revealed that individuals and groups involved in stewardship activities can have a fundamental role in influencing the way in which users of a resource, in this case water, interact with the governance systems, procedures and entities associated with it. SES, as a continually emerging scholarly field, represents one of many ways of understanding these types of complex human-environmental interactions (Binder, Hinkel, Bots, & Pahl-Wostl, 2013).

The results highlighted ways that individuals who are affected by changes to water, such as declining quality, seasonal variation, or specific human-induced events, form organizations that both contribute to and influence SES through governance processes and management activities. The ways that stewardship groups take part in and influence a SES are presented in how an organization positions itself as overlapping 'Governance Systems', 'Users' and 'Interactions', variables of Ostrom's framework. Stewardship groups perform specific tasks – or events – which over time combine into a series of events called activities – within a specific area of practice. These events and activities are also conducted with a specific focus on environmental outcomes

and consequently, extend beyond the roles of other variables within a SES, which are currently limited to user-based outcomes. Past refinements to SES frameworks, such as McGinnis and Ostrom (2014), have addressed this in part by expanding SES to include 'actors' instead of just 'users'. The results of this study indicate that there is potential to further distinguish the role of 'stewardship' within the SES framework. While limited in terms of broad generalizability, the results indicate a potential direction of future research in developing additional stewardship and environmental focused variables in the SES framework.

5.4.2. Methodological Contributions

The methodological design of this research project highlights the importance of flexibility in research design. The need for a high response rate in data collection when using Social Network Analysis represents a risk, which emerged to constitute a drawback in this study. This experience highlights the need for flexibility in designing research goals, objectives, and methods, which should form an important consideration in future studies.

5.4.3. Substantive Contributions

This research findings offer new insights into community stewardship and water governance by addressing fundamental gaps in the understanding of how individuals involved in stewardship view their roles in water governance in Nova Scotia, Canada. The need for this study arose from a devolution and divestiture of responsibility for water by successive, and multiple levels of governments. The result has been a jurisdictional vacuum in the area of water in Nova Scotia where it is unclear which governance entity ultimately assumes responsibility for water issues. This study identified that stewardship groups have the potential to, in the right enabling circumstances, fill some of the governance void in water issues by ensuring that water issues are addressed when needed. These enabling circumstances include having appropriate events, established activities, and defined areas of practice that both engage members of a community and transcend governance institutions and jurisdictional fragmentation. However, these need to be supported by mechanisms that help support the sustainability of the stewardship groups themselves.

This research contribution can be especially pertinent to individuals who are involved in shaping water policy, such as government officials, scholars, and practitioners who must navigate the institutional decision-making processes of water governance, as well as to individuals involved in stewardship groups themselves. For individuals involved in shaping water policy, this study identified the need for a much broader awareness of stewardship in the context of water governance in addition to the well-established role of stewardship in water management. Policy shapers in particular should be aware of the ways stewardship groups can organize people and gather information. At the same time, policy shapers should be cognisant of ways in which stewardship emerges and forms, the factors that contribute to the ongoing sustainability of the group, and the challenges and limitations of stewardship when deciding on how to best utilize stewardship to achieve environmental goals. For individuals involved in stewardship, this study identified the processes stewardship groups can use to influence water governance, as well as the potential challenges and limitations of this involvement throughout the lifespan of an organization. These individuals should be aware of these challenges and limitations when making decisions about a stewardship group's broader involvement in water governance.

5.5. Strengths and Limitations of this Study

5.5.1. Study Strengths

This study benefited from the relationships that the CURA H2O team had developed with study participants. Prior to the start of this project, the CURA H2O team had contacted and worked with several key individuals involved in community-based water stewardship groups to assist in developing potential research objectives that complimented the CURA H2O research themes. These discussions prior to the development of this project were pivotal in influencing the study design. In addition, the CURA H2O team was able to communicate and liaise with these individuals throughout this study and after its completion.

5.5.2. Study Limitations

The lack of transferability and dependability of the results to potential future studies is a limitation of this study. While the initial design of this study, and of qualitative case studies in

general (Yin, 2003), required that it could not necessarily be replicated even in similar circumstances, these limitations are still notable. The purposive and small sample of participants in this study, as well as their geographic proximity within the same province, creates a limitation in terms of broad generalizability or transferability outside of the specific Nova Scotia context. Similarly, the dependability of this study is limited by the methodological decisions that I made. The use of Social Network Analysis, which having not achieved the desired results, compelled me to revise the initial research objectives.

In addition, a further limitation in this study is that even though participants all share similar characteristics – namely, involvement in a stewardship group – these communities of participants are not homogeneous (Kearney & Berkes, 2007). It is likely that many different perspectives, even within individual stewardship groups, were not captured as the participants included only one interviewee for each stewardship group in this study. In addition, as a result of the devolution of responsibility to different levels of government and their departments and agencies (Bakker & Cook, 2011; Hill et al., 2008) many different organizations beyond stewardship groups are involved in water governance in Nova Scotia. The perspectives of individuals involved with these other organizations are also not captured in this study. The focus of this study was solely on the perspective of the individuals interviewed and as such other perspectives on water stewardship and water governance are not included.

Regarding the research design and reporting of results, a limitation in the number of participants involved in this study and the "close-knit" nature of water stewardship groups in Nova Scotia made it difficult to fully explore more controversial views and opinions in detail and share more direct quotations from participants without compromising the confidentiality of the participants. Further studies could indicate this limitation to participants or be crafted in a way that respects participants' abilities to choose what information to reveal.

Finally, the timeline of this study represents a limitation that should be noted. I took an extended leave of absence for approximately 18 months (between 2014 and 2016) during this

study when I was not actively involved in this research project. During this time, the general understanding and knowledge of various concepts discussed in this study have evolved. A notable example is in the concept of SES, where new influential literature has emerged (see for example: McGinnis & Ostrom, 2014). Yet despite these limitations, this thesis still represents a contextual understanding of these issues within the time-period and geographic area in which the study was conducted (e.g. the boundaries of the Province of Nova Scotia).

5.6. Recommendations and Directions for Future Research

This study intended to combine two methodological approaches to understanding human-environmental interactions in the context of environmental stewardship and water governance in Nova Scotia. Additional research aimed at identifying the connections among water stewardship groups and to governance processes would further enhance the understanding of what makes stewardship an important component of human-environmental interactions, particularly water governance. This future research involving community-based water stewardship groups in Nova Scotia can also be extended to include participants in different roles within organizations. While this study examined the perspectives of individuals involved in various roles in stewardship groups, these groups themselves are composed of many individuals with unique views. Seeking out these differing views may provide additional insight into the organizational setting of community stewardship groups.

SES thinking is a continuously emerging topic in environmental conservation and provides a basis of understanding interactions between people and environmental issues(Berkes, 2004; Binder et al., 2013; Folke, 2010; McGinnis & Ostrom, 2014; Olsson et al., 2004; Virapongse et al., 2016). While integrating stewardship with water and broader environmental governance systems continues through the use of advanced social science methods such as Social Network Analysis (Bodin et al., 2011; Rathwell & Peterson, 2012), future research should continue to explore these new methodological ways of connecting these fields of study.

While many stewardship groups undertake functions that are related to both water management and water governance, future research should also provide insight into the operations of entities beyond stewardship groups themselves, although these additional entities should include ones that interact with stewardship groups (such as government agencies and departments, as well as individual users). These different perspectives would provide additional insight into understanding of the role of stewardship in water governance in the Nova Scotia context.

5.7. Conclusion

Water boundaries do not always align with jurisdictional boundaries. In the context of water management and governance in Canada, this has created fragmentation across political and environmental borders (Bakker & Cook, 2011; Cohen, 2012; Hill et al., 2008) necessitating a better understanding of how human systems interact with environmental systems. While the Province of Nova Scotia has identified a need to support integration of stewardship in broader water management activities, governance functions have typically been overlooked (Conrad & Hilchey, 2011). This thesis explored the potential roles and influence of community-based water stewardship groups in Nova Scotia both in the context of water governance and through a Social-Ecological Systems framework. The results of the study conducted provide insight into the ways that the many individuals involved in stewardship groups view their role in broader water governance and overall human-environmental interactions.

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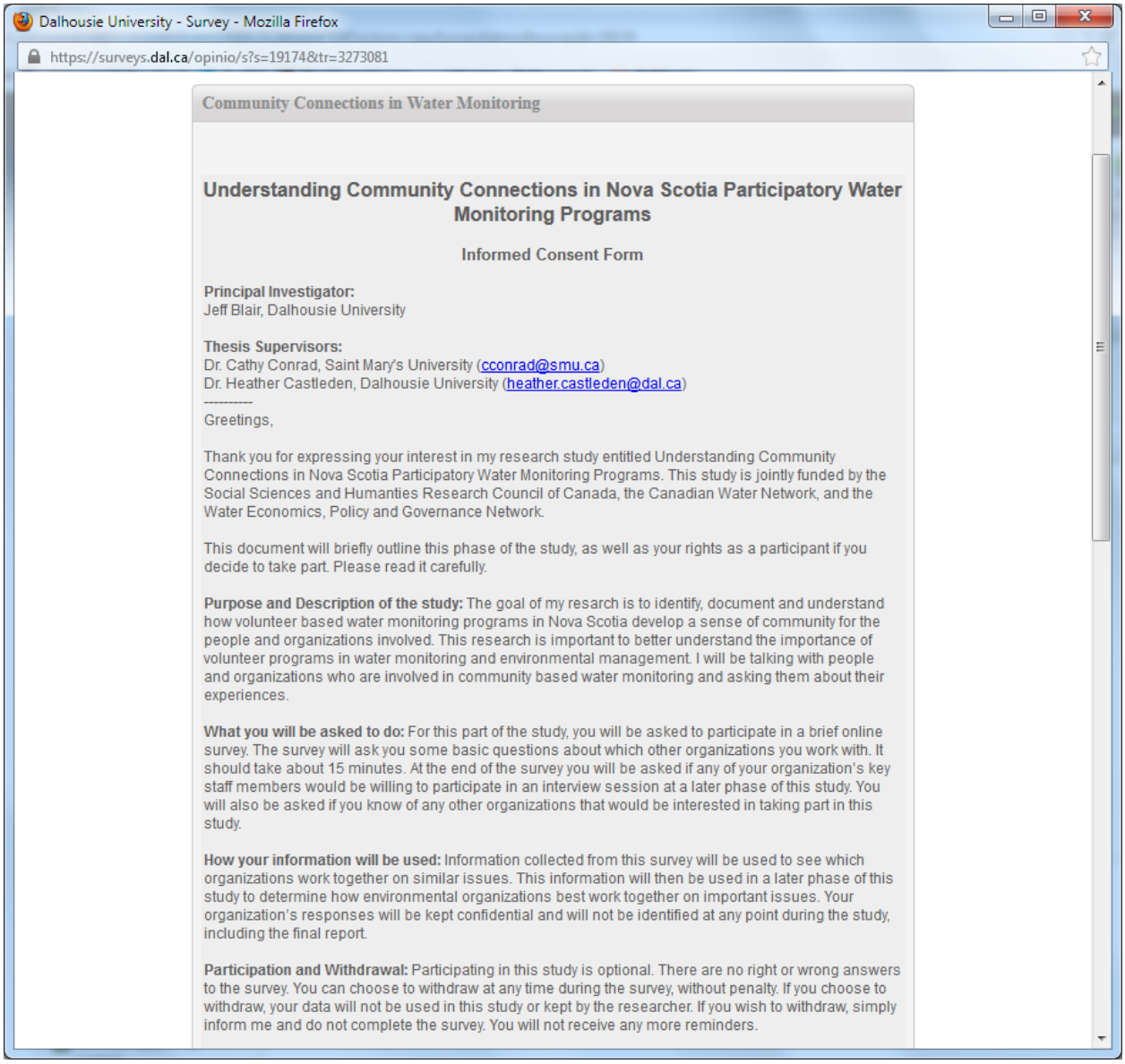
APPENDIX I - THESIS TIMELINE

Dates	Activities
September 2012-December 2012	• Joined CURA H2O
	• Constructed Research Questions
	• Established Supervisory Committee
	• Literature Review
	• Drafted Research Proposal
January 2013-March 2013	• Revised Research Proposal with input from supervisory committee
	• Applied for research funding
April 2013-May 2013	• Drafted Data Collection Instruments (survey and interview guide) and Ethics Application
June 2013-July 2013	• Submitted Ethics Application to Dalhousie University REB
	• Revised application in accordance with requests from reviewers
	• Submitted Approved Application to Saint Mary's University REB
August 2013 – October 2013	• Ethics Approval obtained from both REBs
	• Began Phase 1 – Distributed Online Survey
November 2013 –January 2014	• Completed Phase 1 Data Collection
	• Preliminary Analysis of Phase 1 Data
	• Began Phase 2 – Conducted Interviews
	• Interview Transcription
	• Preliminary Coding and Analysis of Phase 2 Data
January 2014-March 2014	• Participant Verification of Interviews
	• Data Coding
	• Data Analysis
April 2014 – June 2014	• Transmission of Preliminary Findings via CURA H2O Webinar
	• Thesis Writing
June 2014 – September 2014	• Ongoing Data Analysis
	• Thesis Writing
September 2014-December 2015	• Medical Leave of Absence from Studies
January-December 2016	• Resumption and Continuation of Studies
	• Administrative Approvals to Continue Research Project
	• Resumption of Data Analysis
	• Resumption of Thesis Writing

Dates	Activities
	• Revision of Research Goals and Objectives
January-February 2017	• On-going data analysis
	• Writing of Methods
March 2017	• Writing of Results
April 2017	• Writing of Discussion, Conclusion, Introduction, Abstract
May 2017	• Submission of Draft Thesis to Supervisory Committee
	• Review and Revisions of Draft Thesis
Late 2017-Early 2018	• Submission of Defense Version of Thesis to Examining Committee
	• Review of Thesis by Examining Committee
	• Thesis Defense
	• Revision of Thesis as Required by Examining committee
	• Submission of Final/Approved Thesis to Faculty of Graduate Studies

APPENDIX II - PHASE 1 SURVEY

Step 1: Informed Consent:




Dalhousie University - Survey - Mozilla Firefox
https://surveys.dal.ca/opinio/s?s=19174&tr=3273081
Confidentiality: Information collected from the survey, including organization names, will be kept locked in a secure area at Dalhousie University. No identifying information will be made available to anyone except the Principal Investigator and the Research team. However, there is always a small chance that responses may be recognized by others. All electronic data will be kept on password protected computers and hard drives at Dalhousie University for a maximum of 5 years following the completion of the study.
Outcomes and Benefits: While this research may not immediately benefit you or your organization, in the long term, your participation will assist in generating new knowledge about water monitoring programs. In turn, this will help others, such as governments and the general public, understand the value of community involvement in environmental management.
Risks and Discomforts: The risk involved in participating in this survey is minimal. The survey does not ask any sensitive questions about your organization. However, if you do feel that your organization is at risk you may withdraw from the study without consequence.
Questions: If you have any questions, please don't hesitate to contact me by email, telephone or mail at the information listed below.
Thanks,
Jeff Blair,
BA, MES (candidate)

School for Resource and Environmental Studies
Dalhousie University
Kenneth C. Rowe Management Building
6100 University Avenue, Suite 5010
Halifax NS B3H 4R2
Email: jbblair@dal.ca
Telephone: 902-441-2531
If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Catherine Connors, Director, Research Ethics, Dalhousie University at 902-494-1462, ethics@dal.ca.

By clicking "I agree", you agree to, and understand your rights as a participant of this study.
You agree and understand that:
- You will be participating in a graduate student research study and the information you provide will be used in research.
- Your participation is voluntary and you will not be compensated.
- You are free to withdraw from this study at any time without penalty by not completing the survey and informing the researcher.
I agree
I do not agree
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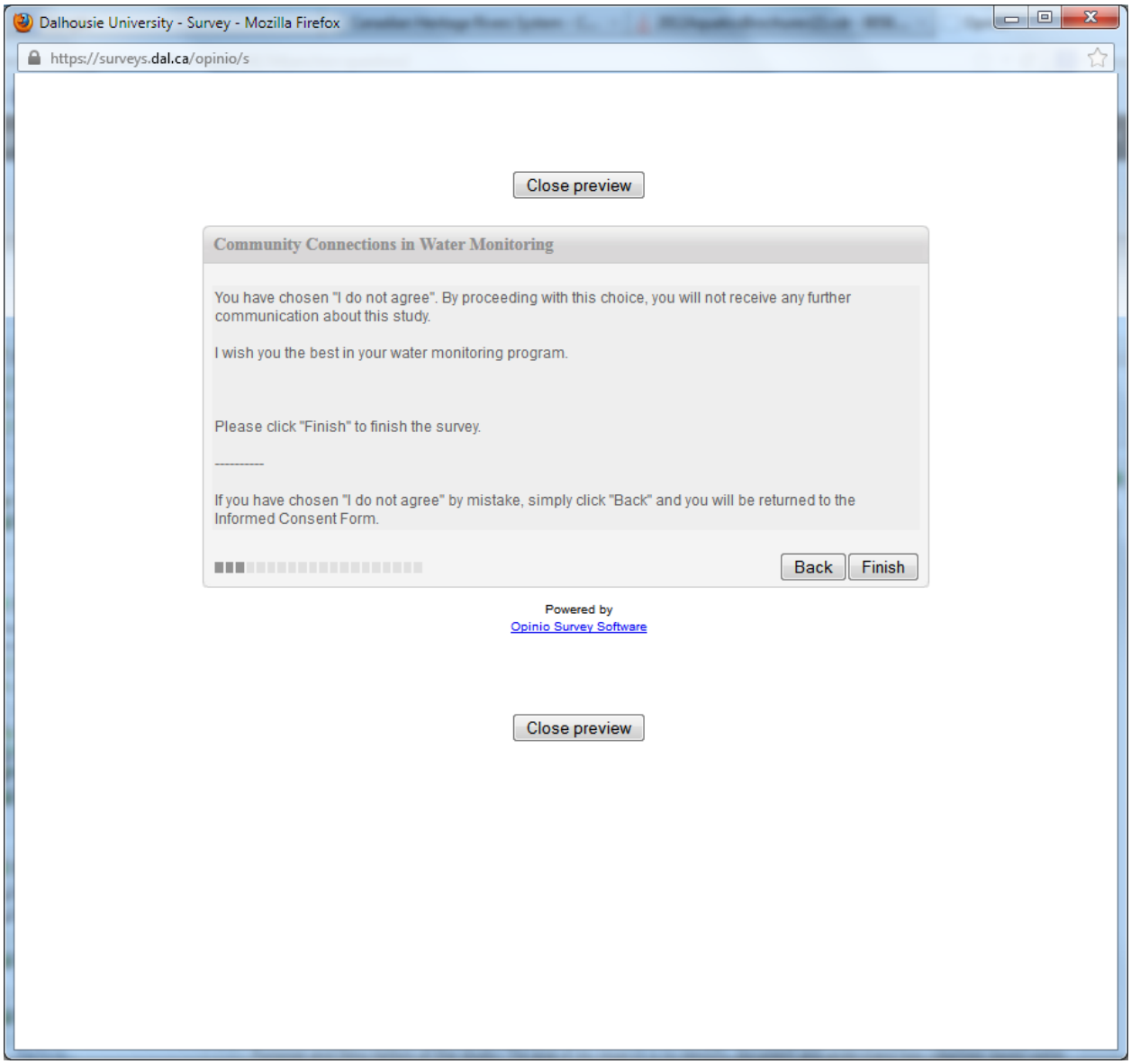
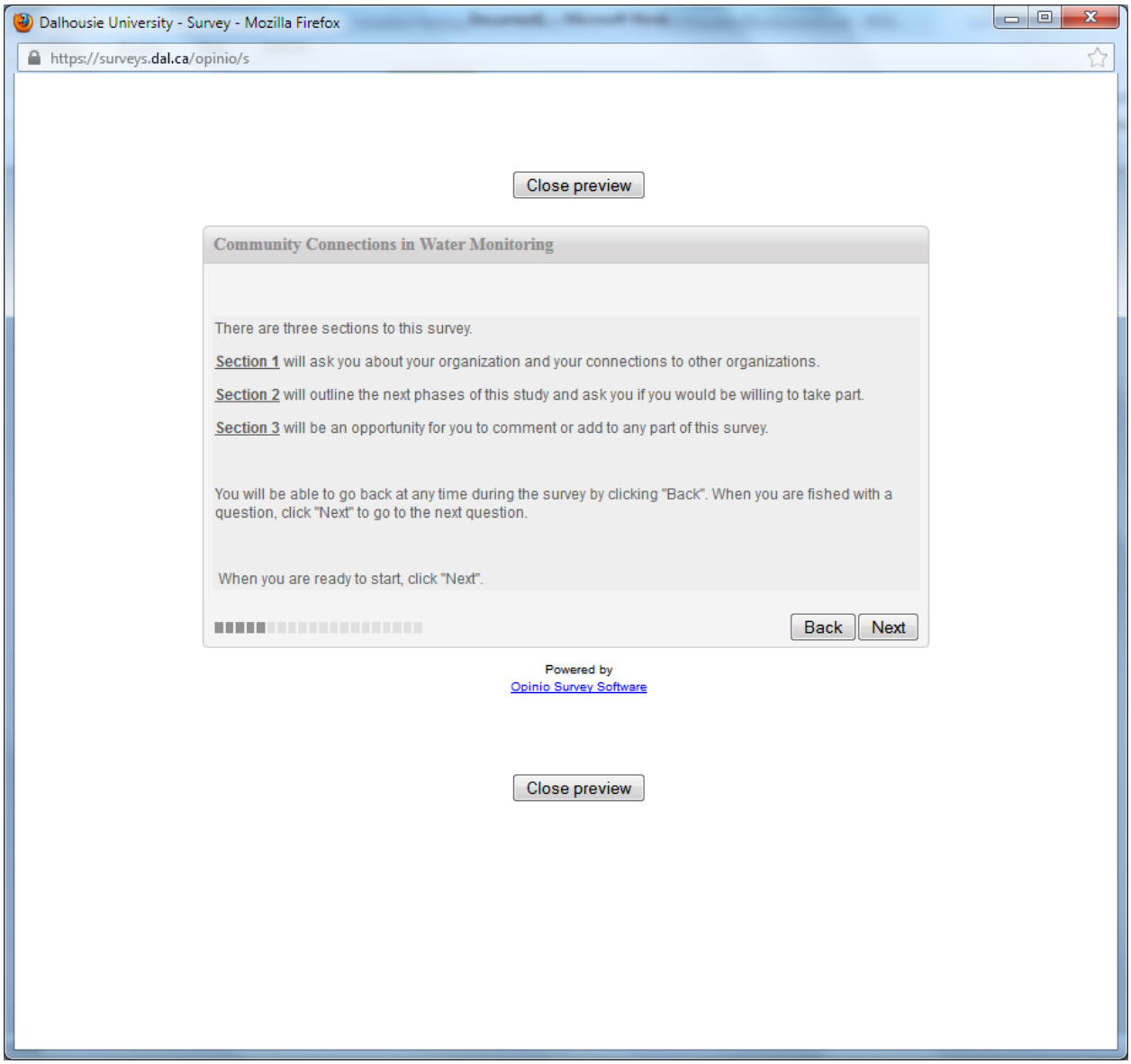
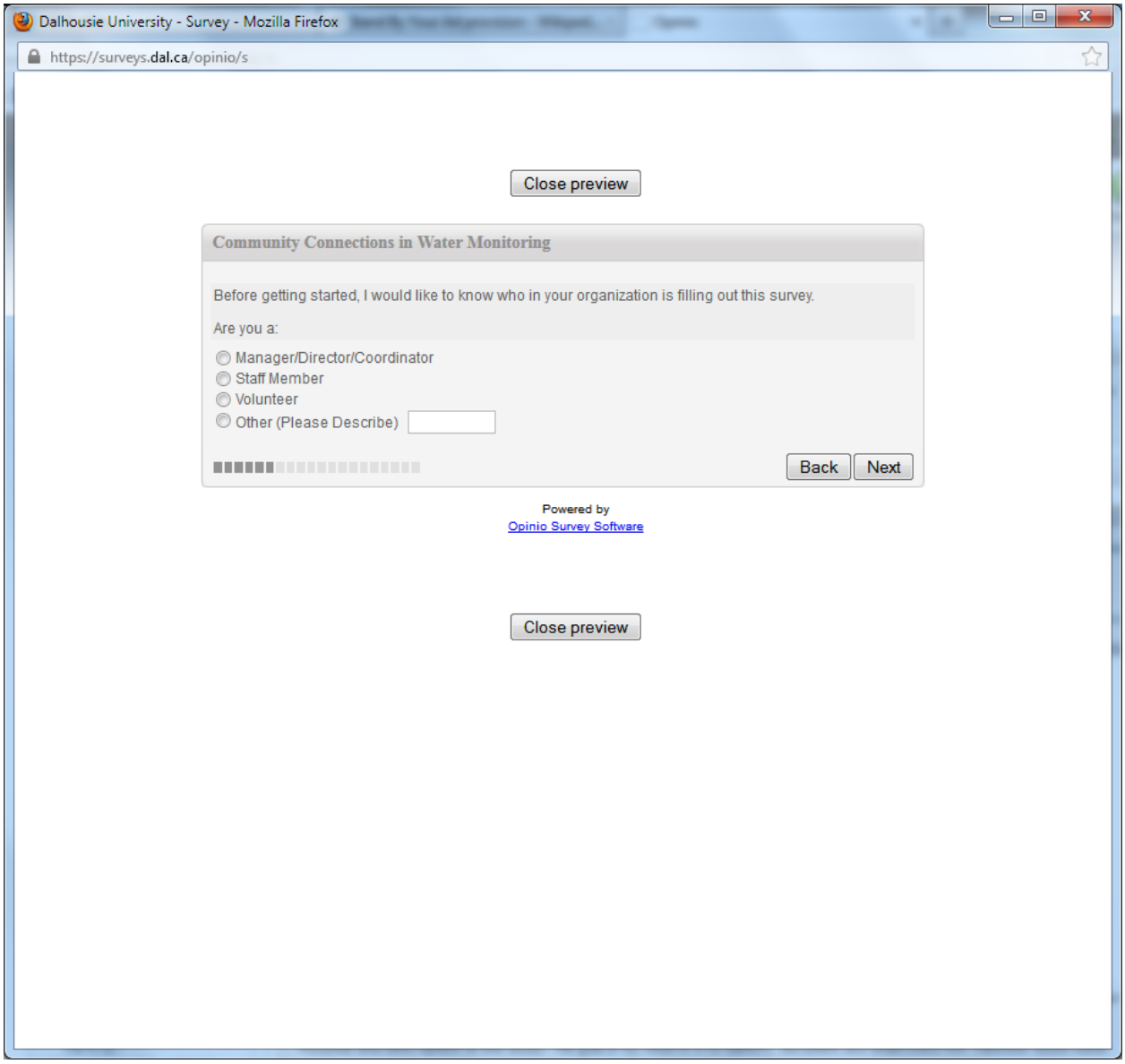
If respondent does not agree:



If respondent agrees – proceed to survey questions:

Step 2: Survey Questions




Dalhousie University - Survey - Mozilla Firefox
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Community Connections in Water Monitoring
Before getting started, I would like to know who in your organization is filling out this survey.
Are you a:
Manager/Director/Coordinator
Staff Member
Volunteer
Other (Please Describe)
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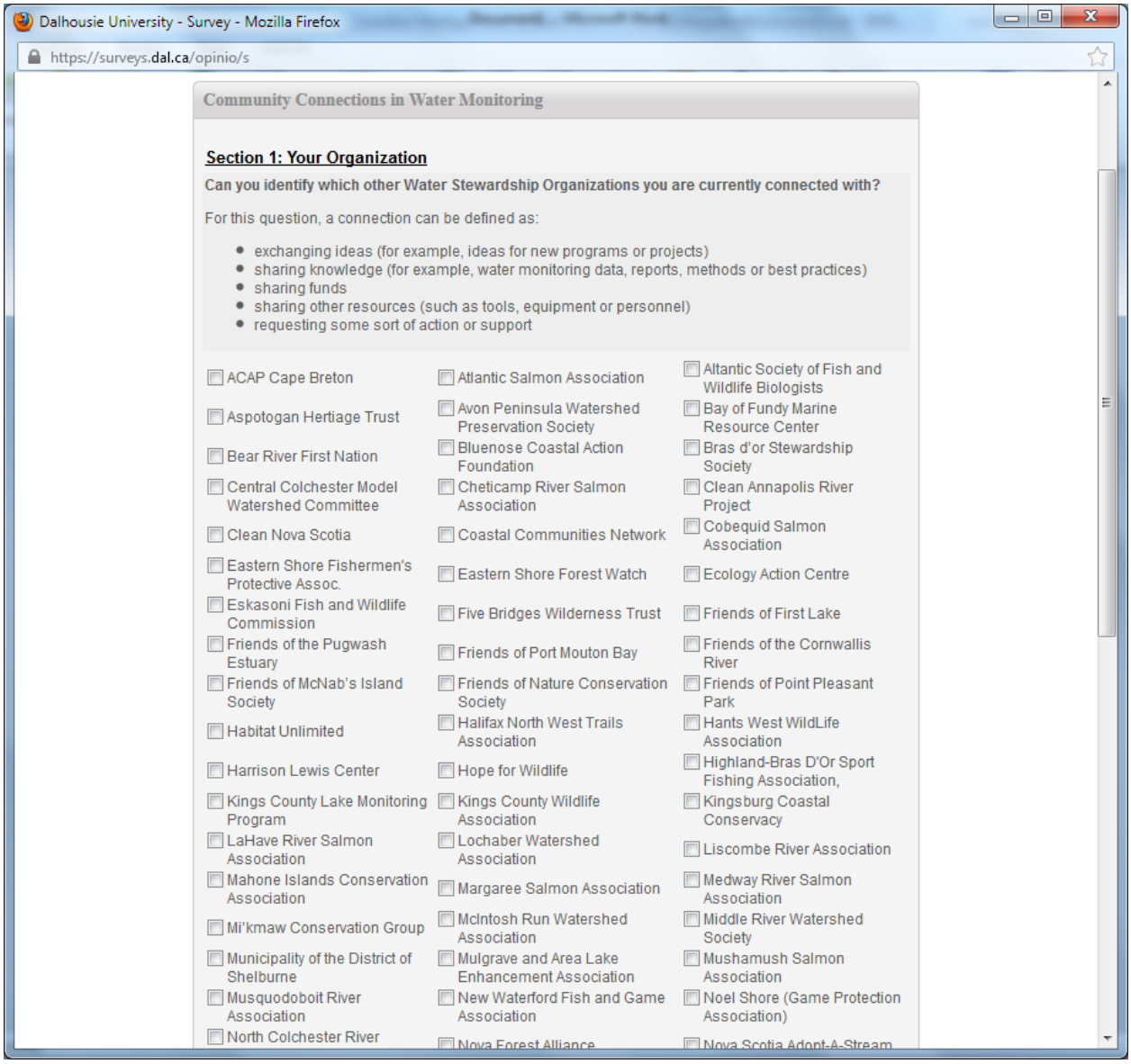
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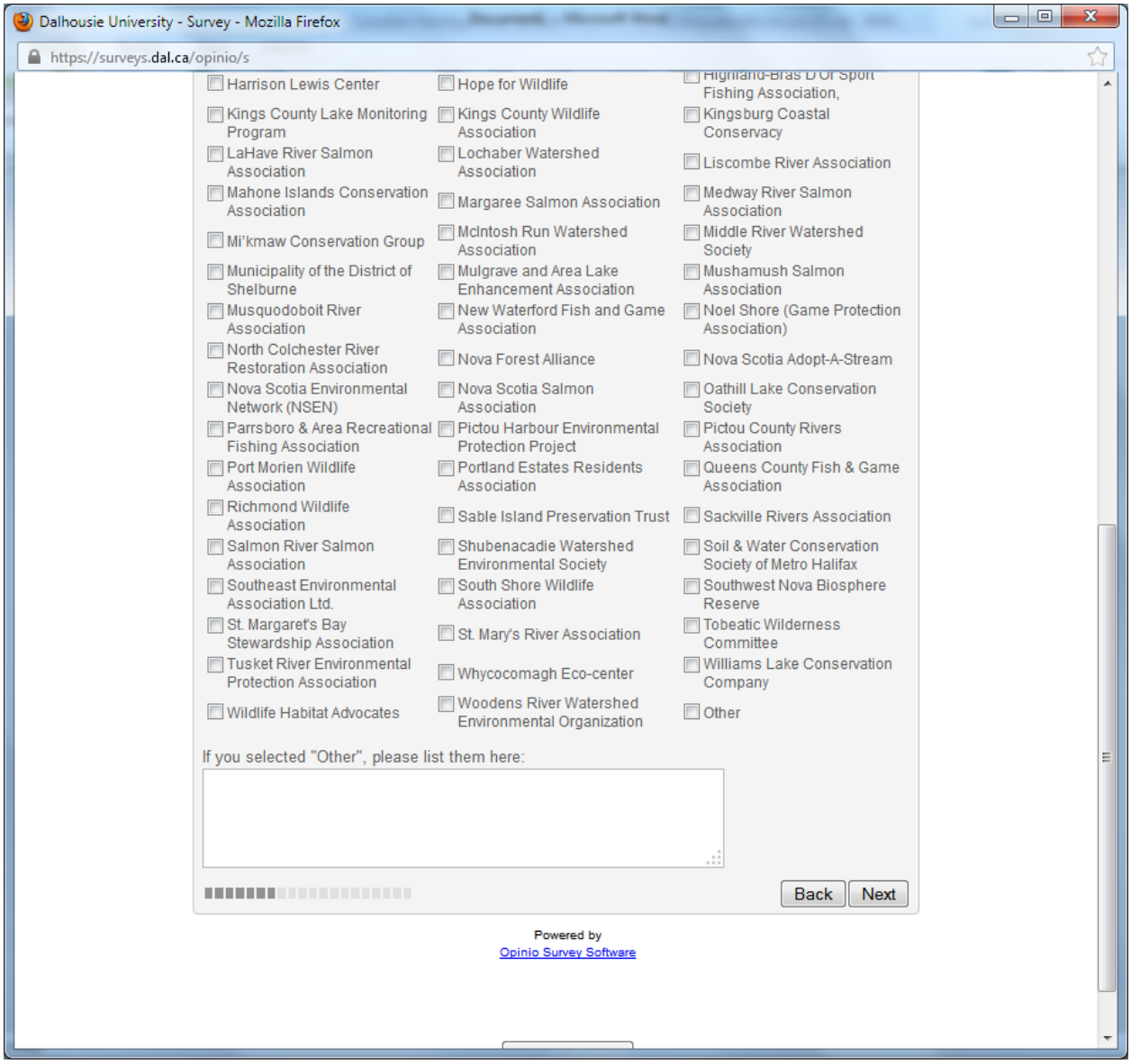
Community Connections in Water Monitoring
Section 1: Your Organization
Can you identify which other Water Stewardship Organizations you are currently connected with?
For this question, a connection can be defined as:
exchanging ideas (for example, ideas for new programs or projects)
sharing knowledge (for example, water monitoring data, reports, methods or best practices)
sharing funds
sharing other resources (such as tools, equipment or personnel)
requesting some sort of action or support
ACAP Cape Breton
Aspotogan Hertiage Trust
Bear River First Nation
Central Colchester Model Watershed Committee
Clean Nova Scotia
Eastern Shore Fishermen's Protective Assoc.
Eskasoni Fish and Wildlife Commission
Friends of the Pugwash Estuary
Friends of McNab's Island Society
Habitat Unlimited
Harrison Lewis Center
Kings County Lake Monitoring Program
LaHave River Salmon Association
Mahone Islands Conservation Association
Mi'kmaw Conservation Group
Municipality of the District of Shelburne
Musquodoboit River Association
North Colchester River
Atlantic Salmon Association
Avon Peninsula Watershed Preservation Society
Bluenose Coastal Action Foundation
Cheticamp River Salmon Association
Coastal Communities Network
Eastern Shore Forest Watch
Five Bridges Wilderness Trust
Friends of Port Mouton Bay
Friends of Nature Conservation Society
Halifax North West Trails Association
Hope for Wildlife
Kings County Wildlife Association
Lochaber Watershed Association
Margaree Salmon Association
McIntosh Run Watershed Association
Mulgrave and Area Lake Enhancement Association
New Waterford Fish and Game Association
Nova Forest Alliance
Altantic Society of Fish and Wildlife Biologists
Bay of Fundy Marine Resource Center
Bras d'or Stewardship Society
Clean Annapolis River Project
Cobequid Salmon Association
Ecology Action Centre
Friends of First Lake
Friends of the Cornwallis River
Friends of Point Pleasant Park
Hants West WildLife Association
Highland-Bras D'Or Sport Fishing Association,
Kingsburg Coastal Conservacy
Liscombe River Association
Medway River Salmon Association
Middle River Watershed Society
Mushamush Salmon Association
Noel Shore (Game Protection Association)
Nova Scotia Adopt-A-Stream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Harrison Lewis Center
Hope for Wildlife
Highland-Bras D'Or Sport Fishing Association,
Kings County Lake Monitoring Program
Kings County Wildlife Association
Kingsburg Coastal Conservacy
LaHave River Salmon Association
Lochaber Watershed Association
Liscombe River Association
Mahone Islands Conservation Association
Margaree Salmon Association
Medway River Salmon Association
Mi'kmaw Conservation Group
McIntosh Run Watershed Association
Middle River Watershed Society
Municipality of the District of Shelburne
Mulgrave and Area Lake Enhancement Association
Mushamush Salmon Association
Musquodoboit River Association
New Waterford Fish and Game Association
Noel Shore (Game Protection Association)
North Colchester River Restoration Association
Nova Forest Alliance
Nova Scotia Adopt-A-Stream
Nova Scotia Environmental Network (NSEN)
Nova Scotia Salmon Association
Oathill Lake Conservation Society
Parrsboro & Area Recreational Fishing Association
Pictou Harbour Environmental Protection Project
Pictou County Rivers Association
Port Morien Wildlife Association
Portland Estates Residents Association
Queens County Fish & Game Association
Richmond Wildlife Association
Sable Island Preservation Trust
Sackville Rivers Association
Salmon River Salmon Association
Shubenacadie Watershed Environmental Society
Soil & Water Conservation Society of Metro Halifax
Southeast Environmental Association Ltd.
South Shore Wildlife Association
Southwest Nova Biosphere Reserve
St. Margaret's Bay Stewardship Association
St. Mary's River Association
Tobeatic Wilderness Committee
Tusket River Environmental Protection Association
Whycocomagh Eco-center
Williams Lake Conservation Company
Wildlife Habitat Advocates
Woodens River Watershed Environmental Organization
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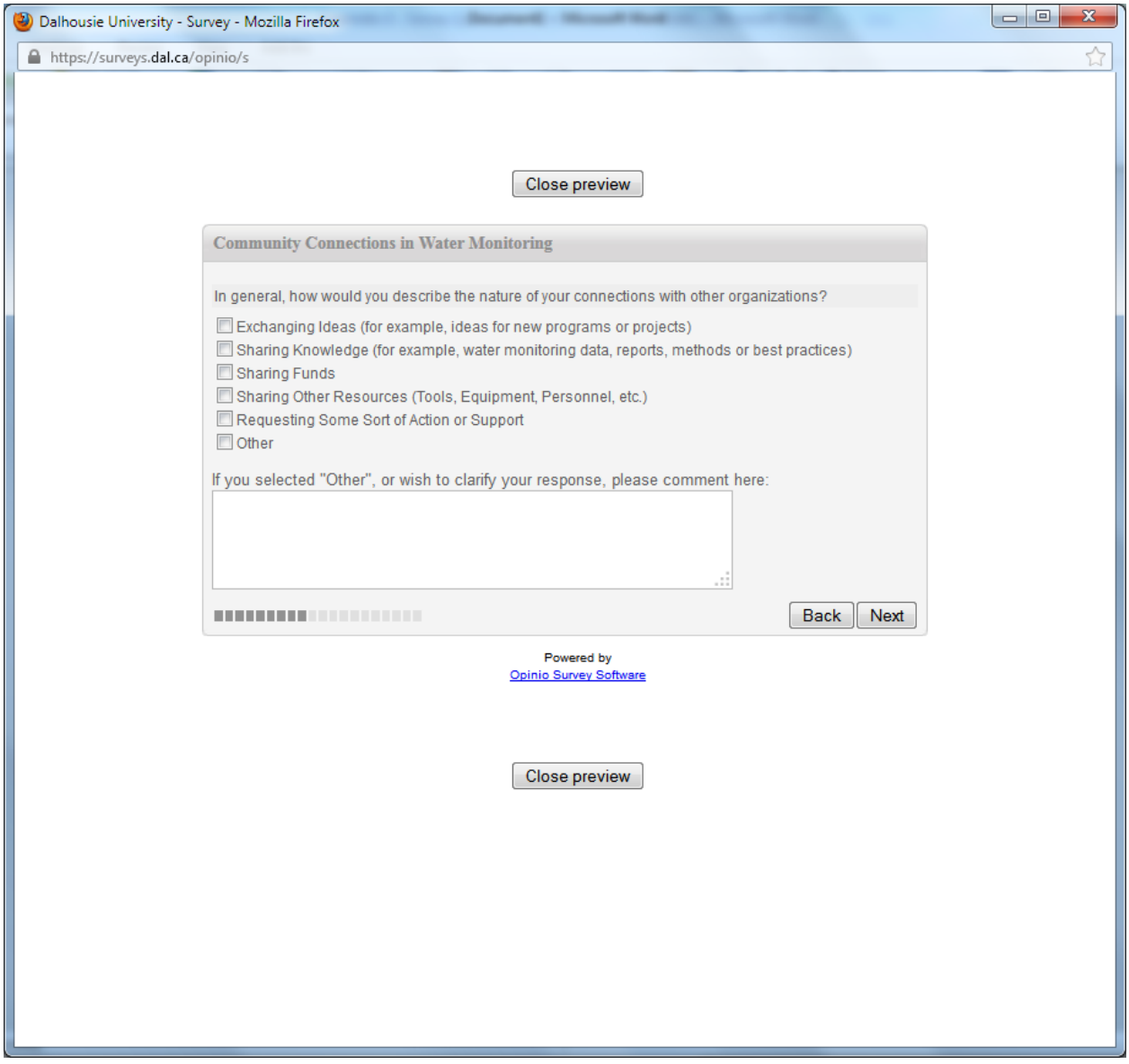
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Community Connections in Water Monitoring
In general, how would you describe the nature of your connections with other organizations?
Exchanging Ideas (for example, ideas for new programs or projects)
Sharing Knowledge (for example, water monitoring data, reports, methods or best practices)
Sharing Funds
Sharing Other Resources (Tools, Equipment, Personnel, etc.)
Requesting Some Sort of Action or Support
Other
If you selected "Other", or wish to clarify your response, please comment here:
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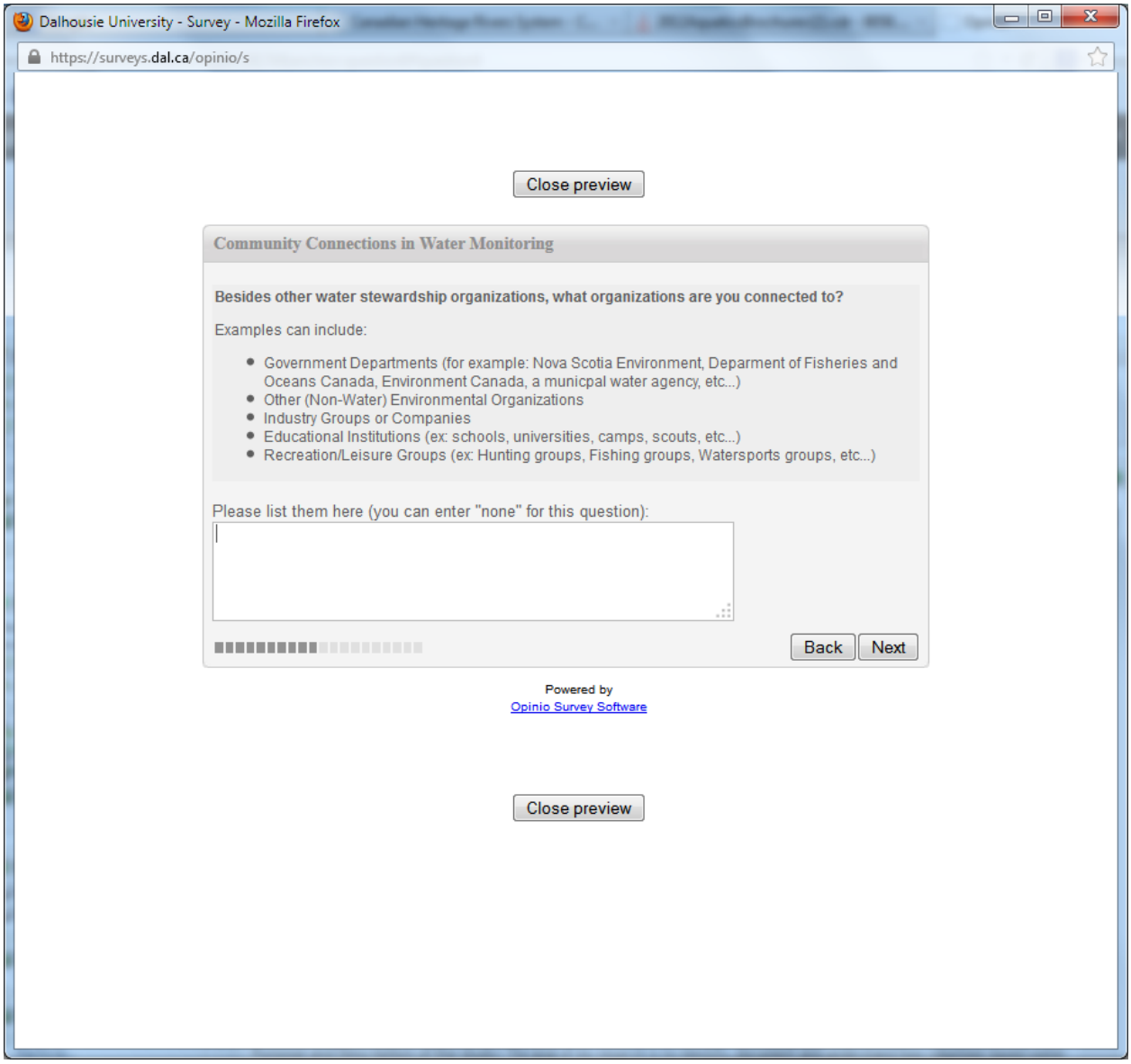
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Community Connections in Water Monitoring
Besides other water stewardship organizations, what organizations are you connected to?
Examples can include:
Government Departments (for example: Nova Scotia Environment, Deparment of Fisheries and Oceans Canada, Environment Canada, a municpal water agency, etc...)
Other (Non-Water) Environmental Organizations
Industry Groups or Companies
Educational Institutions (ex: schools, universities, camps, scouts, etc...)
Recreation/Leisure Groups (ex: Hunting groups, Fishing groups, Watersports groups, etc...)
Please list them here (you can enter "none" for this question):
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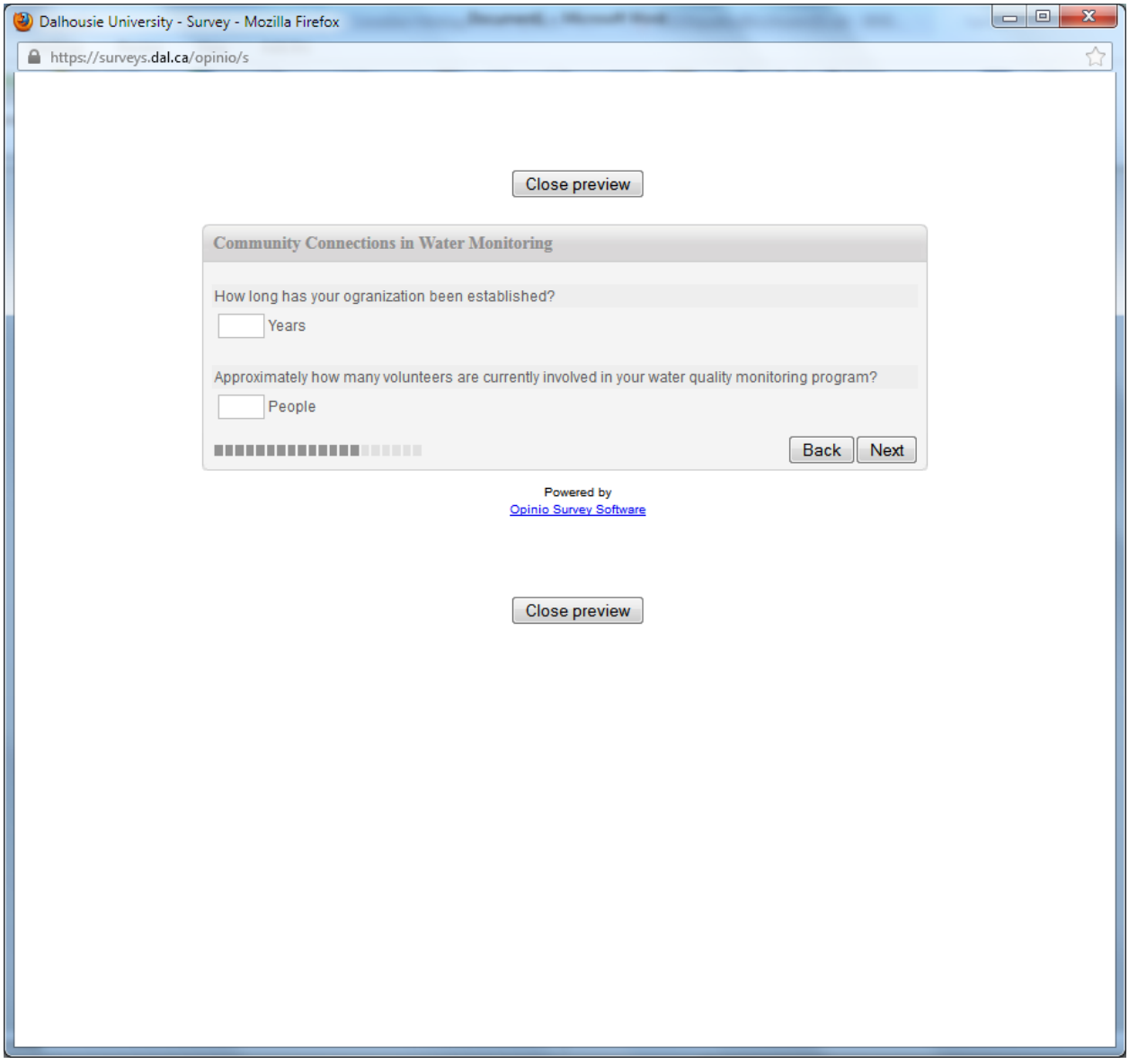
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Community Connections in Water Monitoring
How long has your ogranization been established?
Years
Approximately how many volunteers are currently involved in your water quality monitoring program?
People
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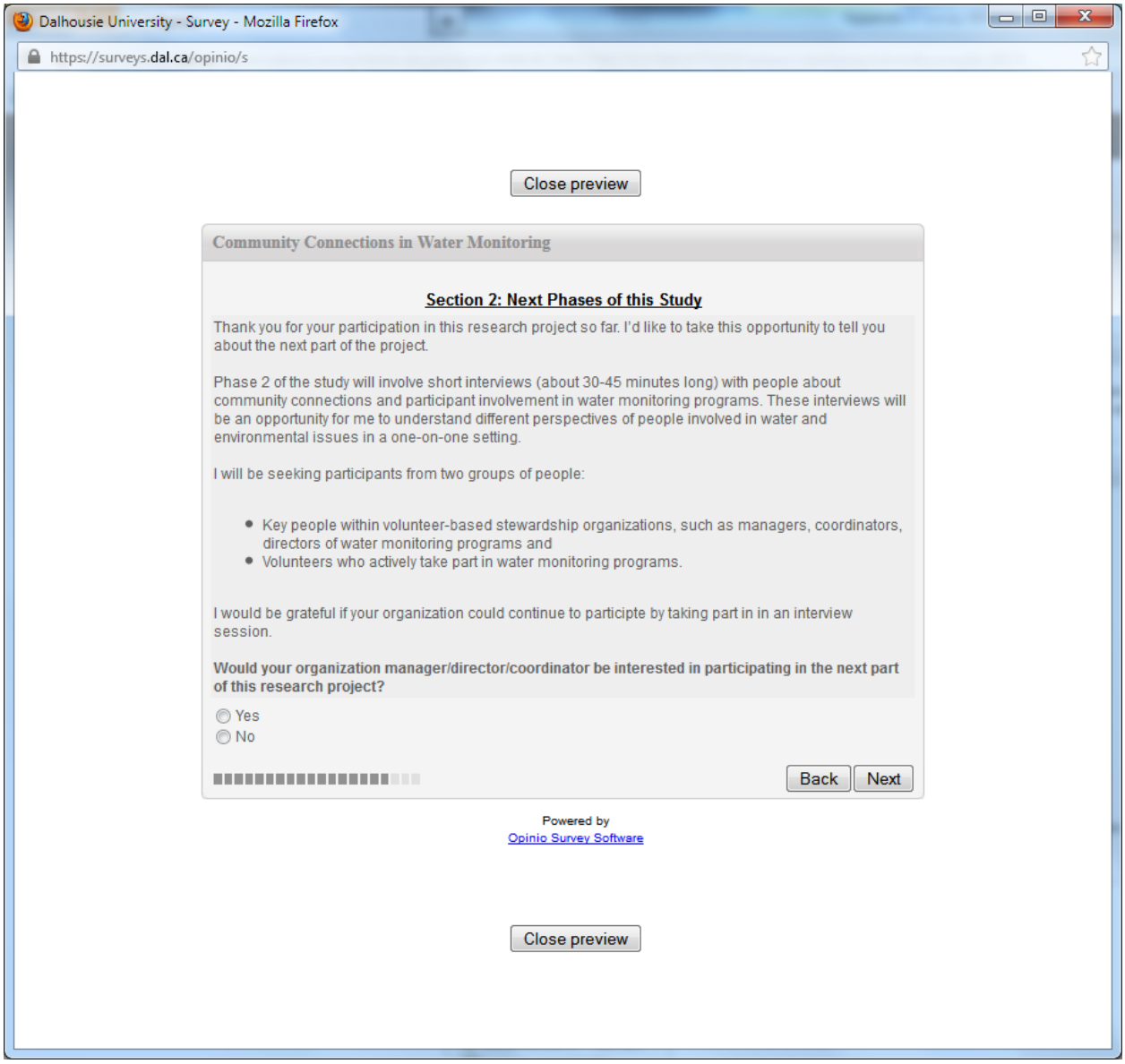
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Community Connections in Water Monitoring
Section 2: Next Phases of this Study
Thank you for your participation in this research project so far. I'd like to take this opportunity to tell you about the next part of the project.
Phase 2 of the study will involve short interviews (about 30-45 minutes long) with people about community connections and participant involvement in water monitoring programs. These interviews will be an opportunity for me to understand different perspectives of people involved in water and environmental issues in a one-on-one setting.
I will be seeking participants from two groups of people:
Key people within volunteer-based stewardship organizations, such as managers, coordinators, directors of water monitoring programs and
Volunteers who actively take part in water monitoring programs.
I would be grateful if your organization could continue to participte by taking part in in an interview session.
Would your organization manager/director/coordinator be interested in participating in the next part of this research project?
Yes
No
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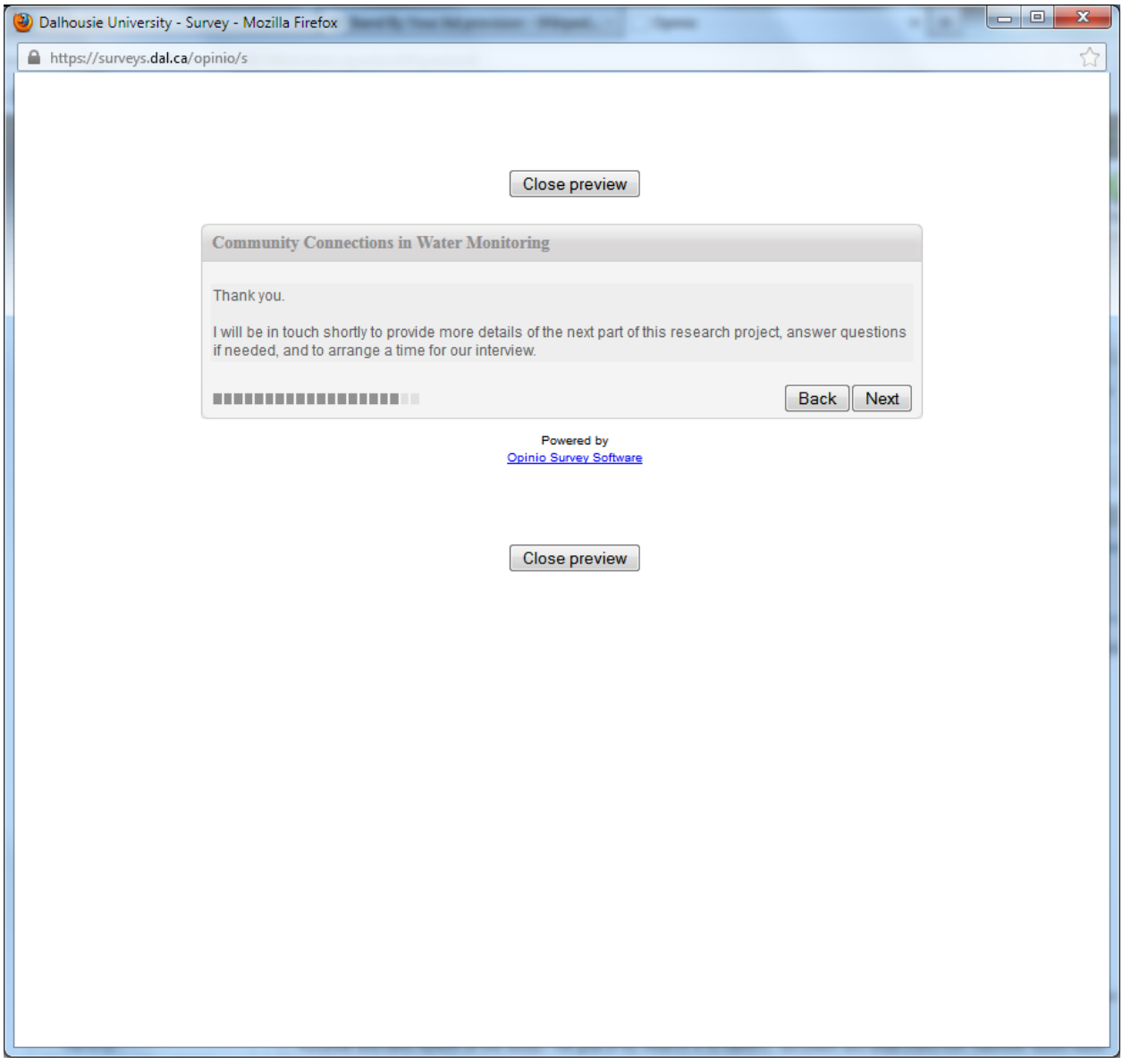
Close preview

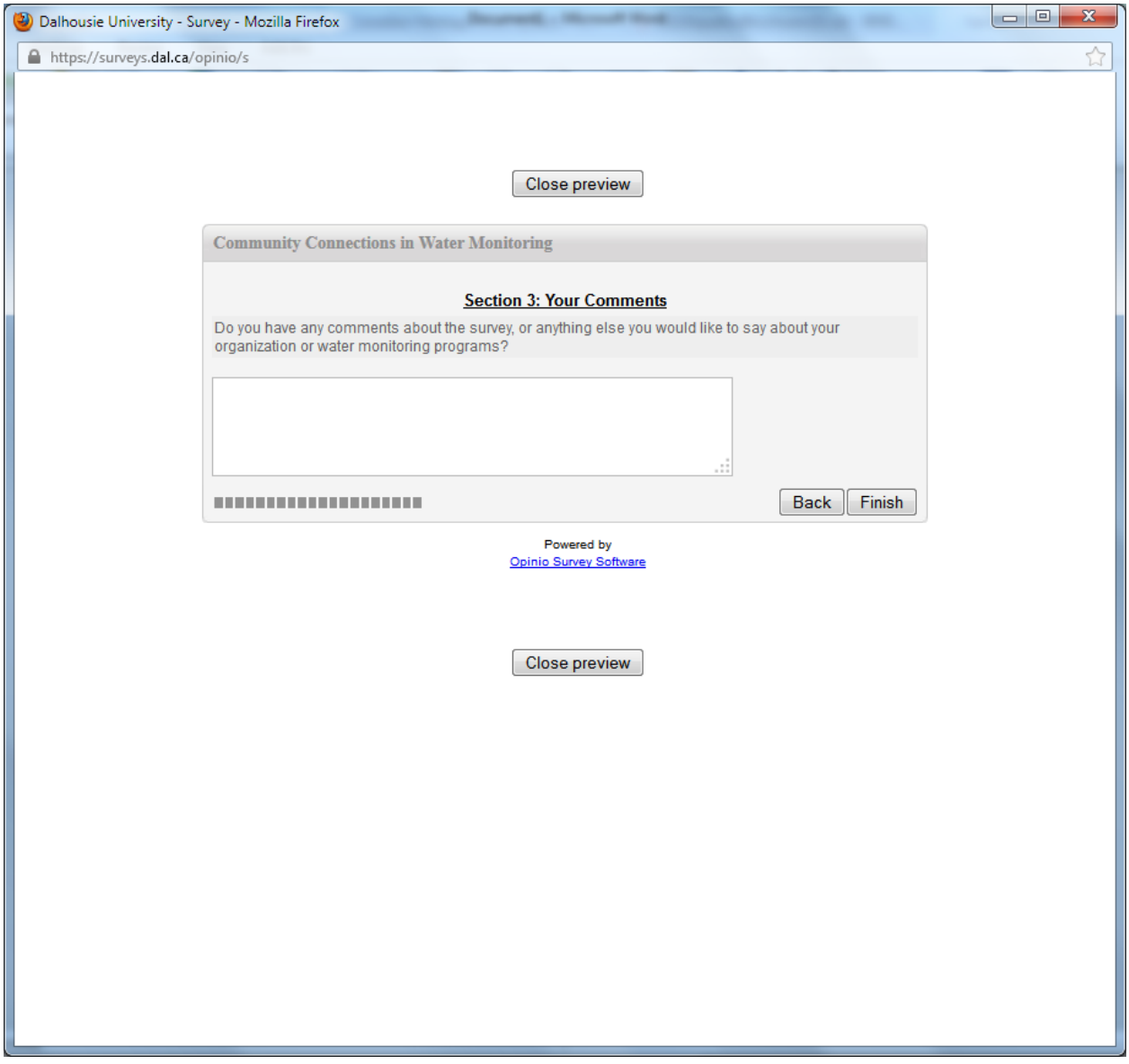
If YES



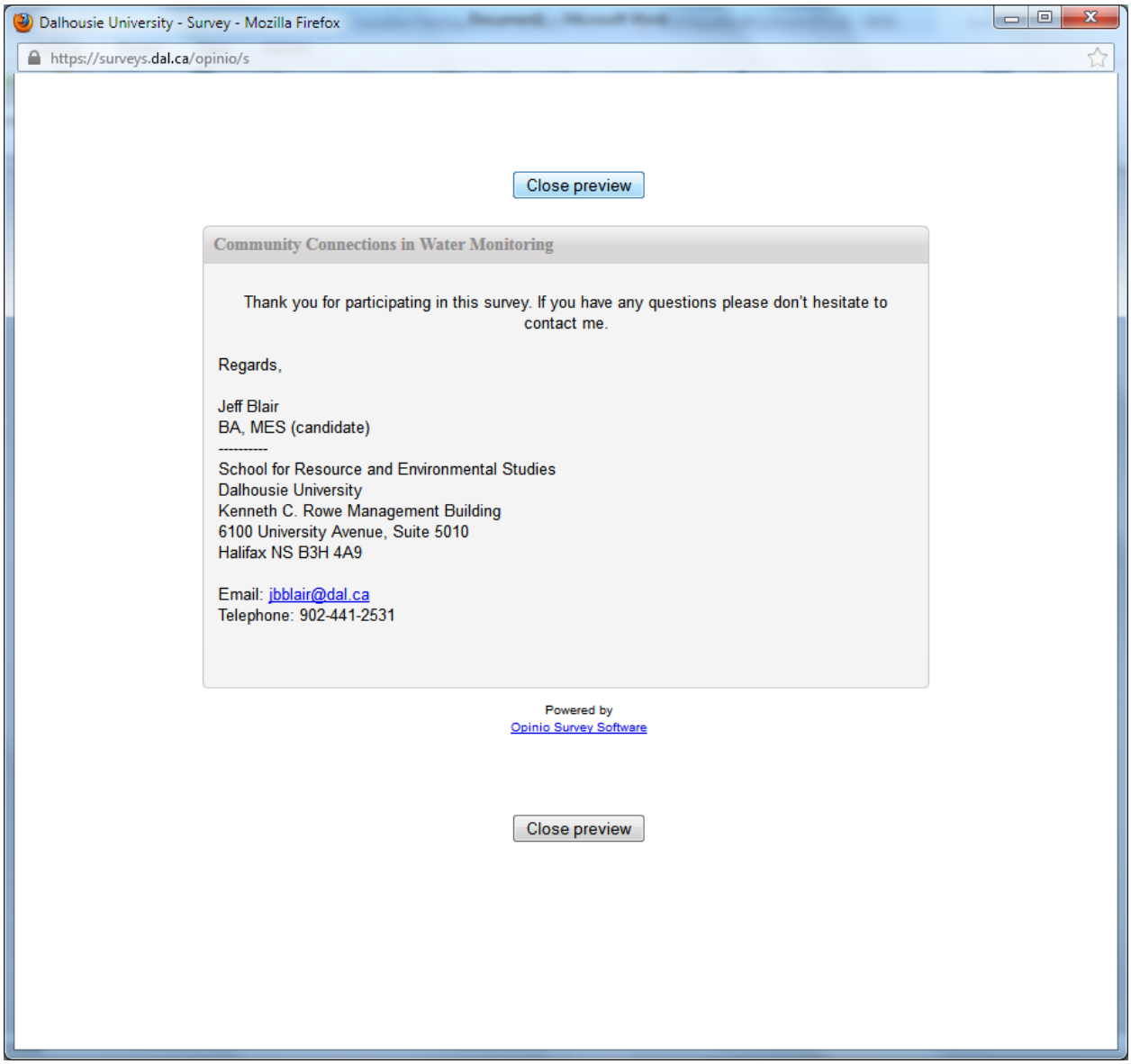
And continue survey with Step 3.

If NO, continue survey:

Step 3: Participant Comments



Step 4: End Survey



APPENDIX III - PHASE 2 INTERVIEW GUIDE

Preamble:

Thank you for agreeing to take part in my research project. It will help with my research and in the future, will help others better understand community participation in environmental issues. During this interview, I will ask you about a range of topics. In total the interview should last about 30-45 minutes.

I'll be using a digital audio recorder to record our conversation and this way I don't have to write down everything you say, and I can just listen to you. If at any point during the interview you decide that you don't want something you say to be included, simply say so - even after we are finished, and I will not use it. Also, if there is a question or an issue that you are uncomfortable talking about- that's ok, we'll just skip that question and move on.

I'd like to also remind you that your participation is completely voluntary, that you are free to withdraw now or any time until my data analysis is complete and that if you choose to withdraw, none of your information will be used. Any information that is collected from our session will be kept confidential and will be accessed only by me and my thesis supervisors, who have all agreed to confidentiality.

This research will be used to develop presentations and publications related to community based water monitoring in Nova Scotia, including my Master's Thesis. In any of these documents, you will not be identified by name, and all quotations will be identified using a tag, for example: "Participant 1", or a fake name.

Do you have any questions before we get started?

Prompts:

<u>Organization</u>

1. Can you tell me a little bit about your organization?
    a. How long have you been established?
    b. What sort of activities and programs do you run?
2. What would you say is the main purpose of your organization?
    a. Is it to enhance awareness? What kind of awareness? How do you generate awareness?
    b. Is it to address a specific community concern? What kind of concern? Why is it a concern?

Water Monitoring

3. How is your organization involved in water monitoring and management?
4. What sorts of tools and equipment do you use?
5. How often do you do it?
6. What are you looking for when you are monitoring?
7. Beyond monitoring, do you engage in any [stream, lake, river] restoration?

Participation

8. How would you describe the volunteers participating in your organization's programs?
    a. Who are they? (Socio-economic: Age, Gender, Day jobs, etc…) Where do they come from?
    b. How enthusiastic are they?
    c. Are they more or less regular volunteers, or different people for every event?
9. In your opinion, are volunteers important in these kinds of programs? Why?
10. How do you go about generating interest in volunteers?
11. Does your organization face challenges when working with volunteers?

Connections, Community and Social Benefits

12. Can you describe an instance where you have approach another water monitoring organization (for equipment, knowledge, data, volunteers, etc.)?
    a. Why did you have to approach them?
    b. Were they helpful?
13. What about an instance where another organization approached you?
    a. Why did they approach you?
    b. How did you help them?
14. On your survey you indicated that you engage in organizations through <x> ways. (Reference Question 5 on survey)
    a. Can you describe how you do this?
15. Who would you say are some the leaders of water management in Nova Scotia?
    a. In Government?
    b. In the volunteer community?
16. Do you think that there is a need for organizations to work together?
17. Does your organization face any challenges when working with other organizations?

Thank you for participating in this interview. At this time, I'd like to ask you if any volunteers within your organization are willing to participate in an interview session as well.

If YES – Can I have their contact information?

Before we finish I was wondering if there anything else you would like to add to this discussion or if you had any questions for me.

In the next few weeks, I will be transcribing our conversation and I see from your consent form that you would like to review the transcript. I will send that to you by email and give you about a week to review it. If I don't hear from you by then, I'll assume that you are satisfied with it and don't see any need for changes.

OR

In the next few weeks, I will be transcribing our conversation and I see from your consent form that you did not want to review the transcript; I thought I would just mention it again in case you have changed your mind… if yes, see above, if no, then*:*

Thanks again and have a good day.

APPENDIX IV - RESEARCH ETHICS APPROVAL LETTERS

Jeff Blair

From: Sharon Gomes
Sent: July 11, 2013 3:41 PM
To: Jeffrey Blair
Cc: Heather Castleden; Sharon Gomes
Subject: REB # 2013-3028 Letter of Approval

Social Sciences & Humanities Research Ethics Board
Letter of Approval

July 11, 2013

Mr Jeff Blair
Management\Resource & Environmental Studies

Dear Jeff,

REB #: 2013-3028
Project Title: Understanding Community Connections in Nova Scotia Participatory Water Monitoring Programs

Effective Date: July 11, 2013
Expiry Date: July 11, 2014

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Sincerely,

[redacted]
Dr. Sophie Jacques, Chair

Post REB Approval: On-going Responsibilities of Researchers

After receiving ethical approval for the conduct of research involving humans, there are several ongoing responsibilities that researchers must meet to remain in compliance with University and Tri-Council policies.

1. Additional Research Ethics approval

1

Prior to conducting any research, researchers must ensure that all required research ethics approvals are secured (in addition to this one). This includes, but is not limited to, securing appropriate research ethics approvals from: other institutions with whom the PI is affiliated; the research institutions of research team members; the institution at which participants may be recruited or from which data may be collected; organizations or groups (e.g. school boards, Aboriginal communities, correctional services, long-term care facilities, service agencies and community groups) and from any other responsible review body or bodies at the research site

2. Reporting adverse events
Any significant adverse events experienced by research participants must be reported **in writing** to Research Ethics **within 24 hours** of their occurrence. Examples of what might be considered "significant" include: an emotional breakdown of a participant during an interview, a negative physical reaction by a participant (e.g. fainting, nausea, unexpected pain, allergic reaction), report by a participant of some sort of negative repercussion from their participation (e.g. reaction of spouse or employer) or complaint by a participant with respect to their participation. The above list is indicative but not all-inclusive. The written report must include details of the adverse event and actions taken by the researcher in response to the incident.

3. Seeking approval for protocol / consent form changes
Prior to implementing any changes to your research plan, whether to the protocol or consent form, researchers must submit them to the Research Ethics Board for review and approval. This is done by completing a Request for Ethics Approval of Amendment to an Approved Project form (available on the website) and submitting three copies of the form and any documents related to the change.

4. Submitting annual reports
Ethics approvals are valid for up to 12 months. Prior to the end of the project's approval deadline, the researcher must complete an Annual Report (available on the website) and return it to Research Ethics for review and approval before the approval end date in order to prevent a lapse of ethics approval for the research. Researchers should note that no research involving humans may be conducted in the absence of a valid ethical approval and that allowing REB approval to lapse is a violation of University policy, inconsistent with the TCPS (article 6.14) and may result in suspension of research and research funding, as required by the funding agency.

5. Submitting final reports
When the researcher is confident that no further data collection or analysis will be required, a Final Report (available on the website) must be submitted to Research Ethics. This often happens at the time when a manuscript is submitted for publication or a thesis is submitted for defence. After review and approval of the Final Report, the Research Ethics file will be closed.

6. Retaining records in a secure manner
Researchers must ensure that both during and after the research project, data is securely retained and/or disposed of in such a manner as to comply with confidentiality provisions specified in the protocol and consent forms. This may involve destruction of the data, or continued arrangements for secure storage. Casual storage of old data is not acceptable.

It is the Principal Investigator's responsibility to keep a copy of the REB approval letters. This can be important to demonstrate that research was undertaken with Board approval, which can be a requirement to publish (and is required by the Faculty of Graduate Studies if you are using this research for your thesis).

Please note that the University will securely store your REB project file for 5 years after the study closure date at which point the file records may be permanently destroyed.

7. Current contact information and university affiliation
The Principal Investigator must inform the Research Ethics office of any changes to contact information for the PI (and supervisor, if appropriate), especially the electronic mail address, for the duration of the REB approval. The PI must inform Research Ethics if there is a termination or interruption of his or her affiliation with Dalhousie University.

8. Legal Counsel
The Principal Investigator agrees to comply with all legislative and regulatory requirements that apply to the project. The Principal Investigator agrees to notify the University Legal Counsel office in the event that he or she receives a notice of non-compliance, complaint or other proceeding relating to such requirements.

9. Supervision of students
Faculty must ensure that students conducting research under their supervision are aware of their responsibilities as described above, and have adequate support to conduct their research in a safe and ethical manner.

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RESEARCH ETHICS BOARD

Department Office
T 902.420.5728
F 902.496.8772
E ethics@smu.ca

Certificate of Ethical Acceptability for Research Involving Humans

This is to certify that the Research Ethics Board has examined the research proposal:

SMU REB File Number:	13-196
Title of Research Project:	Understanding Community Connections in Nova Scotia Participatory Water Monitoring Programs.
Faculty, Department:	Science, School for Resource and Environmental Science
Faculty Local Supervisor:	Dr. Cathy Conrad
Faculty Supervisor: **Student Investigator:**	Dr. Heather Castleden (Dalhousie University) Jeff Blair

and concludes that in all respects the proposed project meets appropriate standards of ethical acceptability and is in accordance with the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans (TCPS 2) and Saint Mary's University relevant policies.

Approval Period: August 8, 2013 – August 8, 2014*

Post-approval Reporting Requirements

ADVERSE EVENT
Adverse Event Report: http://www.smu.ca/academic/reb/forms.html
Adverse events must be immediately reported (no later than 1 business day).
SMU REB Adverse Event Policy: http://www.smu.ca/academic/reb/policies.html

MODIFICATION
FORM 2: http://www.smu.ca/academic/reb/forms.html
Research ethics approval must be requested and obtained prior to implementing any changes or additions to the initial submission, consent form/script or supporting documents.

YEARLY RENEWAL*
FORM 3: http://www.smu.ca/academic/reb/forms.html
Research ethics approval is granted for **one year only**. If the research continues, researchers can request an extension one month before ethics approval expires.
FORM 4: http://www.smu.ca/academic/reb/forms.html
Research ethics approval for course projects is granted for **one year only**. If the course project is continuing, instructors can request an extension one month before ethics approval expires.

CLOSURE
FORM 5: http://www.smu.ca/academic/reb/forms.html
The completion of the research must be reported and the master file for the research project will be closed.

*Please note that if your research approval expires, no activity on the project is permitted until research ethics approval is renewed. Failure to hold a valid SMU REB Certificate of Ethical Acceptability or Continuation may result in the delay, suspension or loss of funding as required by the federal granting Councils.

On behalf of the Saint Mary's University Research Ethics Board, I wish you success in your research.

[redacted]

Dr. Jim Cameron, Ph.D.
Chair, Research Ethics Board, Saint Mary's University

APPENDIX V – CODING SUMMARY TABLES

Table 13: Summary of coding results for Social-Ecological System variables from Ostrom (2009) framework

Variable and Category Name	Count of References in all interview transcripts	Percentage of all coded text
ECO - Related Ecosystems	28	4.71%
ECO1 - Climate patterns	1	
ECO2 - Pollution patterns	16	
ECO3 - Flows into and out of focal SES	11	
GS - Governance Systems	85	14.29%
GS1 - Government organizations	19	
GS2 - Nongovernment organizations	28	
GS3 - Network Structure	6	
GS4 - Property-rights systems	0	
GS5 - Operational rules	8	
GS6 - Collective-choice rules	2	
GS7 - Constitutional rules	7	
GS8 - Monitoring and sanctioning processes	15	
I – Interactions	207	34.79%
I1 - Harvesting levels of diverse users	1	
I2 - Information sharing among users	44	
I3 - Deliberation processes	15	
I4 - Conflicts among users	11	
I5 - Investment activities	7	
I6 - Lobbying activities	15	
I7 - Self-organizing activities	64	
I8 - Networking activities	50	
O – Outcomes	31	5.21%
O1 - Social performance measures (eg. efficiency, equity, accountability, sustainability)	10	
O2 - Ecological performance measures (eg. overharvested, resilience, bio-diversity, sustainability)	10	
O3 - Externalities to other SES	11	
RS - Resource Systems	55	9.24%
RS1 - Sector (eg. water, forests, pasture, fish)	6	
RS2 - Clarity of system boundaries	7	

Variable and Category Name	Count of References in all interview transcripts	Percentage of all coded text
RS3 - Size of resource system	2	
RS4 - Human-constructed facilities	10	
RS5 - Productivity of system	7	
RS6 - Equilibrium properties	8	
RS7 - Predictability of system dynamics	8	
RS8 - Storage characteristics	4	
RS9 – Location	3	
RU - Resource Units	13	2.18%
RU1 - Resource Unit Mobility	0	
RU2 - Growth or replacement rate	2	
RU3 - Interaction among resource units	3	
RU4 - Economic value	2	
RU5 - Number of units	0	
RU6 - Distinctive markings	2	
RU7 - Spatial and Temporal distribution	4	
S - Social, economic and political settings	36	6.05%
S1 - Economic development	5	
S2 - Demographic trends	14	
S3 - Political stability	1	
S4 - Government resource policies	6	
S5 - Market incentives	7	
S6 - Media organization	3	
U - Users	140	23.53%
U1 - Number of Users	6	
U2 - Socioeconomic attributes of users	22	
U3 - History of use	5	
U4 - Location	14	
U5 - Leadership or entrepreneurship	25	
U6 - Norms or social capital	19	
U7 - Knowledge of SES or mental models	11	
U8 - Importance of resource	14	
U9 - Technology used	24	
Total	**595**	**100%**

Table 14: Summary of Coding Results for 'Connections' related themes

Code Name	Count of References in all interview transcripts	Percentage of all coded text
Connections to Broader Community	32	31.07%
Connections to Individuals	10	9.71%
Connections to Natural Environment, Resources and Ecosystems	19	18.45%
Connections to Other Organizations	42	40.78%
TOTAL	**103**	**100.00%**

Table 15: Summary of Coding Results for Primary-Level Inductive Codes

Code Name	Count of References in all interview transcripts	Percentage of all coded text
Organization Lifespan	5	5.56%
Youth Engagement	2	2.22%
Development	4	4.44%
Demographics	15	16.67%
Students	10	11.11%
Activity	18	20.00%
Water Governance	18	20.00%
Jurisdiction (sub-code)	4	4.44%
Capacity	14	15.56%
TOTAL	**90**	**100.00%**

Table 16: Summary of Coding Results for Secondary-Level Inductive Codes

Code Name	Count of References in all interview transcripts	Percentage of all coded text
Issue or Event	25	20.00%
Communication	15	12.00%
Conciliation	3	2.40%
Formation Challenge	3	2.40%
Formation Story	12	9.60%
Advisory Council Members	3	2.40%
Funding	8	6.40%
Success Story	11	8.80%
Organization-developed Tool or Product	1	0.80%
Engagement Approaches	11	8.80%
Project Leadership	3	2.40%
Other Challenges	22	17.60%
Competing Priorities (sub-code)	4	3.20%
Reasons and Rationale	4	3.20%
TOTAL	**125**	**100.00%**

APPENDIX VI – COPYRIGHT RELEASE LETTERS

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