

**COMMUNITY-BASED ENVIRONMENTAL MONITORING IN STREAM  
ECOSYSTEMS:  
POINTING THE WAY TO SUSTAINABLE SALMON MANAGEMENT ON  
VANCOUVER ISLAND, BRITISH COLUMBIA, CANADA**

**by**

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**A thesis report submitted to the School of Environmental Studies in conformity with  
the requirements for the degree of Master of Environmental Studies**

**Queen's University**

**Kingston, Ontario, Canada**

**May 2007**

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## **Acknowledgments**

I would first and foremost like to acknowledge my advisor Dr. Vicki Friesen and my advisory committee of Dr. Diane Lawrence and Dr. Brian Cumming. You all encouraged me through the research process and always ensured that I had enough insightful and challenging feedback to make this a wonderful research experience.

Thank you to the School of Environmental Studies at Queen's University that has supported me through 7 years of undergraduate and graduate studies. This includes the many faculty who have guided and honed my interests and skills as well as the generous and kind staff members throughout the School. Of these people, I would like to especially thank Dr. Heather Jamieson, Dr. Peter Hodson, Dr. Alison Goebel, Karen MacIntyre, Wendy Phillips and Kelly Smith. I would also like to especially acknowledge Karen Topping for all her help and regardless of my question, for always having an answer.

I would like to extend my thanks and love to my family for all their support through the progression of my research. Mom, Dad and Andrew, thank you all for your kind words, listening, proofreading and input. I would also like to extend my utmost appreciation to Tante Sjaan, who took me under her wing throughout my time in Kingston.

The completion of my research would not have been possible without the continued support I received from Amy Philip, Hilary Davies, Leah Savage and Julia Bryan. I will never find a group of friends as caring, intelligent and strong as you all.

And finally, many thanks go out to Matthew. For all the love you gave me during the good and the not so good parts of my research, I will never be able to thank you enough.

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### **List of Abbreviations**

CA	Community Advisor
DFO	Department of Fisheries and Oceans Canada
ENGO	Environmental Non-Government Organization
OHEB	Oceans and Habitat Enhancement Branch

## **Executive Summary**

*Community-based environmental monitoring activities are increasing across Canada. In these activities, organizations undertake the assessment of a specific ecosystem attribute, such as a species or a species assemblage, to improve natural resource management. Indeed, this process has been widely acknowledged as critical in British Columbia's salmon enhancement and assessment programs under the direction of the Department of Fisheries and Oceans' Oceans Habitat Enhancement Branch. Through federal support of these initiatives, many community-based organizations are mobilizing on Vancouver Island, British Columbia. However, this increase in willing organizations does not guarantee that monitoring activities are benefiting the management of salmon stocks. Often, groups are unable to maintain a stable volunteer base or to collect data that is useable by resource managers. Here I attempt to determine if indicators for successful community-based monitoring can be used to identify if groups are contributing in a positive and effective manner to their local salmon enhancement initiatives. The indicators most critical for organizational success, as identified through a literature review and interviews with active community-based organizations on Vancouver Island, include: volunteer training, community and educational programs, clear goals and roles, and project follow-up, with the most important identified as funding and fundraising, standardization of methods and protocols, and effective communication strategies. Concurrent implementation of these practices can ensure that best practices for salmon enhancement and assessment programs are employed for sustainable natural resource management of salmon.*

## **1.0 Introduction**

Community-based solutions to local environmental issues have been increasing in scope and numbers throughout North America since the mid 1960's (Lathrop & Markowitz, 1995) and in Canada, most notably since the 1970's (Rutherford, 2007). These solutions can be quite broad and entail only public education on local environmental issues, or can be as specific as the monitoring of a single species in an isolated location. In British Columbia, monitoring campaigns that have been gathering the most attention by citizens and other officials have been those community-led initiatives that pertain to the monitoring and assessment of salmon. (MacDonald *et al*, 2000). These efforts can take the form of groups of concerned citizens willing to volunteer their time and efforts to the preservation of local ecosystem health, which has led all levels of government to develop programs to encourage and support these groups as they move towards sustainable management of local natural resources. Active citizen/government monitoring partnerships are seen directly through the Department of Fisheries and Oceans Canada's (DFO) Oceans Habitat Enhancement Branch (OHEB). This interest by governments in community assisted initiatives is a growing trend, not only in British Columbia, but across Canada (Chicoine, 1996; Pollock & Whitelaw, 2005).

### **1.1 Research Objectives and Problem Statement**

Community-based environmental monitoring can contribute to the management of natural resources most effectively through the involvement of the local citizens in the assessment and enhancement processes (Thiessen & Vane, 2000). The role of these citizen volunteers in communities and governments is most beneficial when participation

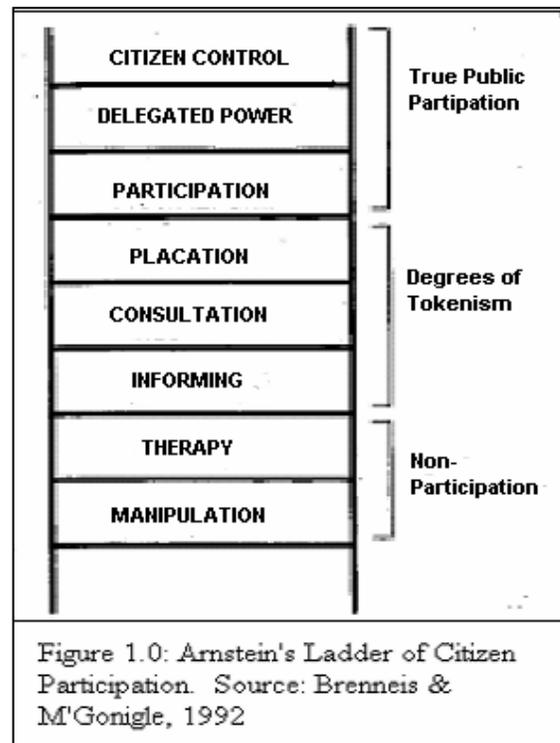
is engaging and long term. Regardless of this benefit in British Columbia, many of the salmon monitoring and assessment organizations initiated by volunteers fail to offer long-term commitment to projects and programs operating within local stream systems (Yarnell & Gayton, 2003). Many have their volunteer numbers dwindle, while others disappear completely after only a few seasons of monitoring. This has led to gaps in information and inconsistent site monitoring in areas integral to salmon enhancement. With increased pressures as a result of continued urbanization and resource extraction on Vancouver Island, short-term and disjointed monitoring may be unable to contribute to the maintenance of healthy stream ecosystems with viable salmon habitat. Not only is this not in the best interests of community groups, it also poses a problem for DFO, whose investment in the OHEB program is entirely dependant on organizational success. As such, when discussing community-based environmental monitoring of salmon stocks in British Columbia, it is equally important to understand why the relationship between these groups and DFO has remained, for the most part, positive.

As a result, a closer examination of the factors that lead to organizational success will be made. This study will assess the historical context of governance and community-based environmental monitoring of salmon stocks in British Columbia. Additionally, it will look at indicators for success of community groups monitoring salmon stocks on Vancouver Island and will aim to aid groups in ensuring the best course of action for monitoring campaigns and the development of a more comprehensive plan for environmental conservation. Assessing the organizational traits that lead to successful community-based environmental monitoring can provide substantial guidance to existing and future organizations in the design of monitoring programs. If a group is aware of the recommendations stemming from the identification of indicators of success of

organizations specific to Vancouver Island, then programs can alter their approach to maximize community and environmental impact of monitoring (Yarnell & Gayton, 2003) This report should be viewed as an exploratory study enabling a model for future quantitative research to be undertaken.

## 1.2 Environmental Governance

Before community-based environmental monitoring for the purposes of salmon stock assessment can be addressed, we must discuss the overall concept of governance within which citizen engagement and community-based environmental monitoring falls. The linkage between the on the ground data collectors and the decision making process should be addressed as, ultimately, it is the volunteers organizing to instigate change in



how local natural resources and environments are being managed. Salmon management initiatives operating on Vancouver Island are moving not only to monitor and assess stocks returning to B.C. streams to spawn, but also to influence local decision making to influence long term salmon conservation initiatives. This influence is being achieved through volunteer presence on local management boards and councils (Morton, 2006).

Governance is not a new concept and has been keenly discussed in academic circles with respect to public participation in decision making processes. One of the earliest

mentions of governance in the literature was in 1969 with Arnstein's Ladder of Public Participation (Figure 1). With this ladder Arnstein presented three ranges of citizen participation, from nonparticipation to tokenism to citizen empowerment. Through the inclusion of the topmost "citizen empowerment", Arnstein argues that it is the consultation with the public and subsequent interaction between all parties involved in the decision making process that creates the most effective means of achieving a comprehensive plan to ensure a feasible and realistic solution to the problem at hand (Brennis & M'Gonigle, 1992). Arnstein states that the main outcome of this ladder would ultimately be citizen control of the issue, whether it be in regard to the decision-making process or formulation of local solutions to local problems.

Today, governance has evolved to be broadly perceived as a point when decisions include all of the collective actors in addressing the issue and determining the appropriate solution within the context of both social and environmental issues (Tonn *et al.*, 2000; Savan *et al.*, 2004). Savan and colleagues (2004) go even farther and specifically define environmental governance as the process by which decision-making processes have a direct impact on the biophysical environment and encompass a holistic viewpoint of the ecosystem in question. The management of the natural environment under the banner of environmental governance would then encompass a scenario where the roles of governments and citizens are dynamic and have the potential to shift, and where citizens maintain an active role in the delegation of power over local resources and maintain democratic accountability for the decisions being made.

### **1.2.1 Criticisms of environmental governance**

Environmental governance is not without its critics, both from outside and from within the theory. Many feel that greater citizen access to the decision-making process

will ultimately lead to marked slowing of any decision crucial to the maintenance of local ecosystem health (Brenneis & M'Gonigle, 1992). This has been demonstrated in the surge of task forces and roundtables that bring together all parties affected by an issue.

Processes that have consensus as their outcome can be time consuming and difficult due to the complexity of issues in a local context (Rutherford, 2007). As a result, critical environmental decisions may get lost in the layers of bureaucracy required by governance (Savan et al., 2000). Furthermore, the consensus and participatory approach to decision making has the potential to result in the “lowest possible denominator decision”, where all parties continuously lower their standards of environmental management to gain a consensus and move forward on action (Lane & McDonald, 2005).

Differences in the players involved in the process and differences in community structure also contribute to the inability of institutional arrangements and roles to remain static. This has been openly criticized as making governance too complex and inoperative on many different scales. Governments, non-governmental organizations (NGOs), community groups and industry all operate at multiple scales, resulting in differing approaches to environmental problems and any subsequent planning. The exclusion of these multiple levels would then eliminate any overlap occurring at the management level, subsequently limiting the applicability of environmental governance (Lane & McDonald, 2005).

Lane & McDonald (2005) also argue that the use of local or community knowledge in the decision making process does not contain enough hard science or policy knowledge to make decisions on an ecosystem level. The authors point to concerns with citizen knowledge having a selective vision in choosing what decisions to make, and that these,

essentially selfish decisions, would not necessarily align with what is in fact beneficial and imperative for ecosystem health.

### **1.3 Community-Based Environmental Monitoring: Historical Context**

Community-based environmental monitoring involves the active participation of members of the community in ensuring protection of overall local ecosystem health and is considered a major component of environmental governance (Whitelaw, 2002). This participation comes in a variety of forms, including political advocacy, data collection and, the development and implementation of community education initiatives. (Cox, 2006; Currie-Alder, 2005; Pollock & Whitelaw, 2006)

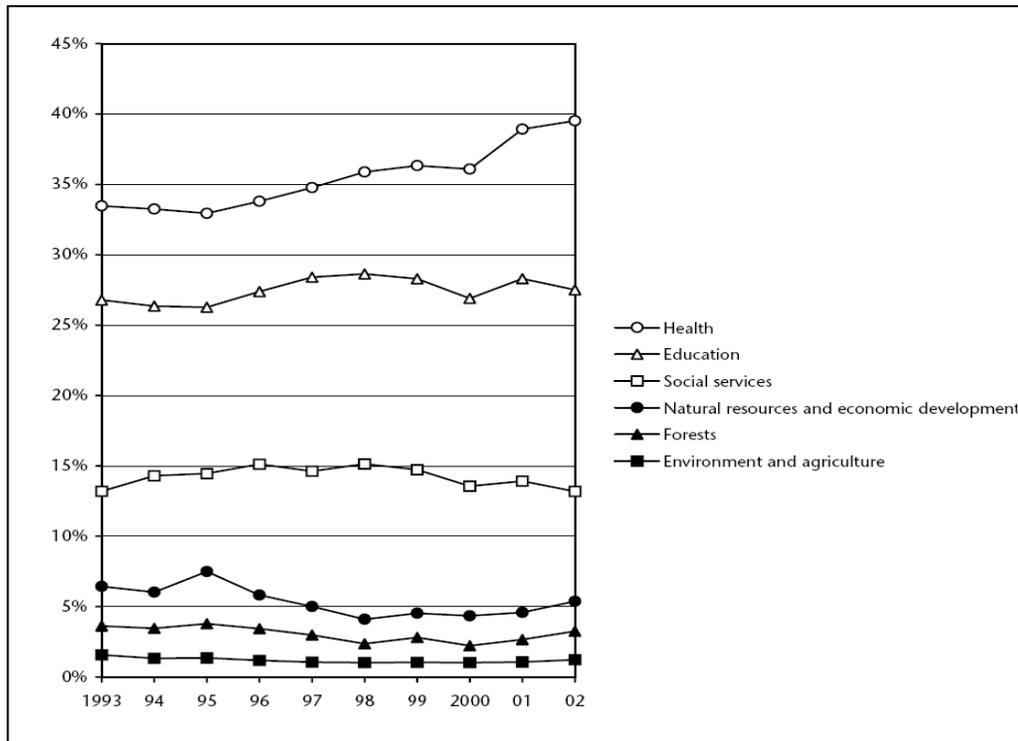
Historically, management of natural resources has been the responsibility of the federal, provincial and municipal levels of government, with specific mandates to carry out any ecological monitoring occurring in stream ecosystems. More recently however, a drastic reduction in government budgets and departments has resulted in a substantial gap in monitoring activities occurring at a national and provincial scale (Krajnc, 2000; Savan *et al.*, 2004).

The most well documented example, and perhaps the catalyst to the recent increase in monitoring activities undertaken by citizens, occurs within the British Columbia Ministry of Environment and DFO (Rosenau & Angelo, 2001; Yarnell & Gayton, 2003; Peterson *et al.*, 2005; Young & Werring, 2006).

#### **1.3.1 Cutbacks to the British Columbia Ministry of Environment**

British Columbia's provincial government has demonstrated a steady downward trend in the budgets of the Ministry of Environment and Ministry of Natural Resources (Gayton, 2003). Although the BC Ministry of the Environment's budget over the past 10

years has decreased by less than 1%, annual expenditures represent less than 3% of the total budget of the Province of British Columbia (Gayton, 2003) (Figure 2).



**Figure 2** Annual expenditures of the Government of British Columbia as a percentage of total budget. Source: Gayton, 2003

The reasoning behind the lack of consistent long-term funding for ecological monitoring projects is rooted in the lack of immediate benefits seen by other provincial departments, such as health. Additionally, no single ministry acknowledges ecological monitoring as a core duty, allowing for short term, incremental funding and staff decreases with each consecutive budget reduction. These factors have resulted in a downloading of responsibilities to community-based environmental monitoring groups, who have risen to provide governments with concrete and immediate action to local environmental degradation for very little cost to the respective government departments (Gayton, 2003). This decrease has resulted in widespread public backlash for a perceived

lack of action over local environmental health and ecosystem integrity, specifically action pertaining to protection of water resources (Savan *et al.*, 2004).

The reductions of qualified and full-time environmental staff had a significant impact on the administration of monitoring and enforcement activities (Krajnc, 2000; Ivey *et al.*, 2002). With fewer human resources at the disposal of government departments, remaining staff are now finding themselves overextended in terms of duties and the geographical extent of their responsibilities. Ministry offices in several smaller jurisdictions have closed, relocating services to a select few municipalities (Peterson *et al.*, 2005). Additionally, cutbacks in human resources have substantially reduced the number of environment specialists operating within the province. This has resulted in remaining staff devolving into environmental “generalists”, performing duties for which they have no definitive experience. Krajnc (2000) states that the emergence of these generalists has resulted in “...less coordination, focus and expertise [...while] perform[ing] new expert tasks in the area of water [protection]”.

### **1.3.2 Cutbacks to the Department of Fisheries and Oceans, Canada**

For the purposes of this research, it is equally important to highlight the budgetary cutbacks occurring at the federal level, specifically within DFO. Broad-brush departmental cutbacks to DFO have had a direct impact on the agency’s operations in British Columbia. DFO has experienced a 23% decrease in funding, representing \$219 million in resources, and is only beginning to regain government financial support under the current federal government (Parsons *et al.*, 1998; Rosenau & Angelo, 2001; DFO, 2007). Most recently, for the 2005/2006 budget year, DFO’s Pacific region was allotted only \$600,000 for monitoring and assessment of salmon populations. This translates to only eight full time staff for an area of 1.4 million km<sup>2</sup> (Young & Werring, 2006). As

previously outlined in the case of the British Columbia's Ministry of Environment, funding reductions have resulted in a significant decrease in programs and human capital within DFO. These cuts perpetuated a significant decrease in government capacity to protect and restore salmon habitat on Vancouver Island as well as the remainder of the province (Rosenau & Angelo, 2001; Peterson *et al.*, 2005; Young & Werring, 2006). This decrease did not go unnoticed with, in 2001, the Auditor General of Canada stating that:

*“...planning was poor and it was slow to develop sustainable fisheries policies and the frameworks to integrate them...it [also] failed to take precautions when its own scientific advice was warning of stock declines. The situation was made worse by the Department's weak enforcement of the Fisheries Act and regulations and its failure to develop an effective, comprehensive process of consultation of stakeholders.”* (in Rosenau & Angelo, 2001)

Although decreases in federal funding to DFO have waned, there still exists an inadequate amount of government control over all waterways in British Columbia. Based on the Government of BC's budget projections, and high population growth on Vancouver Island, Rosenau & Angelo (2001) have demonstrated that there are indicators that even with an increase of new programs and policies pertaining to watershed protection in the province, conditions of inaction and inertia regarding monitoring and restoration will persist. The growing numbers of community-based environmental monitoring organizations that are materializing in British Columbia can then be seen as inherently positive, ensuring that governments remain politically accountable for protection and conservation while filling gaps in data collection.

## **1.4 Community-Based Environmental Monitoring: Components**

The components of community-based environmental monitoring include environmental stewardship, community advocacy, and collective knowledge (EMAN, 2003).

### **1.4.1 Environmental stewardship**

Environmental stewardship is considered an integral component of community-based environmental monitoring and assessment, and ensures that ecosystem management does not treat people as external to the natural environment (Sparkes, 1995). Stewardship encourages people to actively interact with their local environment and understand the natural processes involved in a holistic and systems-based approach to environmental management. The desired outcome is ultimately to develop and maintain a link between humans and the natural environment, giving people stronger motivation for environmental protection. This valuation of the environment is then another step towards functional environmental governance within a community. After any decisions pertaining to salmon stock management have been made by the players in governance, the actual hands-on work required to continuously inform these decisions falls to monitoring and assessment, ultimately referred to as a component of stewardship (Gardner, 1992 *in* Lerner, 1994, Youdes, 2002).

In this study, grassroots stewardship activities take the form of community groups involved in activities to promote local stream ecosystem health. This form of stewardship continues to grow, and improvements to the local environment are beginning at a smaller scale, namely the individual, gradually moving towards the societal paradigm of intrinsic environmental valuation (Gardner, 1992 *in* Lerner, 1993). This form of stewardship relies mostly on the educational system to reach individuals. Programs set up in schools

as well as community education programs are a much needed resource when attempting to reconnect society to nature (Lev *et al.*, 1998)

Stewardship as a component of community-based environmental monitoring also leads to an increase in volunteerism in the region (Lerner, 1992; Donald, 1997). As stewardship takes root in the community, more people are willing to volunteer their time to environmental conservation. The steady interest of volunteers and citizens not only sparks the monitoring and restoration activity, but leads communities to become more active citizens in the decisions affecting their neighborhoods, a critical component of environmental governance.

#### **1.4.2 Advocacy**

Environmental advocacy is considered the next step from environmental stewardship, and has a focus on communication of stewardship results to the public and decision makers (Cox, 2006). Advocacy campaigns, particularly when delivered by stream monitoring groups, are designed to achieve specific changes in the public sphere, increase citizen participation in the government and policy-based programs that are affecting local ecosystems, and build on stewardship initiatives in the area (Cox, 2006).

#### **1.4.3. Collective knowledge**

Collective knowledge is defined as a “common as well as scientific knowledge about the environment and society” (Tonn *et al.*, 2000). The emergence of collective knowledge comes with increased social learning by a community group undertaking monitoring and assessment activities. Monitoring activity carried out by local citizens ensures that knowledge of the natural environment is consistently built upon, deepening the understanding of and the link to the local natural environment. Collective knowledge

can span across community groups in a region, increasing the collaborative links between groups and stakeholders, ensuring that compilation of information across the watershed leads to a common knowledge base and ultimately, a systems-based, adaptive management approach to environmental management in the area (Bowers, 1995; Day & Litke, 1998; MacDonald *et al.*, 2000; Clarkson & Andre, 2002). The incidence of collective knowledge within organizations undertaking salmon assessment on Vancouver Island comes predominantly in the form of traditional ecological knowledge. An example is seen with active Salish, Nuuchahnulth and Kwakiult aboriginal groups on the island, who contribute to monitoring through oral histories and ancestral information on the abundance of salmon on specific streams (Government of British Columbia, 2007). This history is identified as a critical component not only of reconstructing past ecosystems in the area, but also for fostering a cultural link with salmon and salmon habitat in the region (Walter *et al.*, 2000; Kearney *et al.*, 2007).

## **1.5 Community-Based Environmental Monitoring: Problems and Criticisms**

### **1.5.1 Reliability of volunteer data**

Perhaps the biggest criticism of community-based environmental monitoring is the lack of credibility given to volunteers actually doing the monitoring. When results of volunteer monitoring are communicated to the general public or various governing bodies, volunteer information and data run the risk of being labeled as unreliable in conservation movements (McLaughlin & Hilts, 1999). Often, it is simply a lack of trust by scientists and the general public of non-scientists contributing data to any ecosystem management plan or scientific study (Bielak, 2007). There has also been criticism from governmental agencies and employees of the reliability and quality of data being

collected by volunteers generally in the form of the inappropriateness of lay people collecting scientific data. This concern arises not only because of a perceived lack of knowledge by citizens regarding the scientific method but also because of the stigma that only scientifically trained individuals are capable of undertaking this type of activity.

However, the criticism of volunteers obtaining reliable data from monitoring sites has been extensively covered in the literature, where little to no difference between professionals and volunteers has been demonstrated (Heiman, 1997; Fore *et al.*, 2001). Properly trained volunteers must be operating within the site for data and data collection to be accepted as reliable. Regardless of this need for standardization, training remains variable from region to region and even from group to group (Stokes *et al.*, 1989; Stadel & Nelson, 1995; Whitelaw *et al.*, 2003).

### **1.5.2 Commitment**

The commitment of volunteers has also been identified as a problem in using data collected by community-based environmental groups. As unpaid helpers working outside regular business hours, volunteers are perceived to be not as committed to the project because the project is competing with other responsibilities and activities in the volunteer's spare time. Additionally, there is concern that volunteers will lose interest in the monitoring activity due to a significant time commitment to complete training and other protocols (Craig *et al.*, 1995; Stadel & Nelson, 1995).

### **1.5.3 Objectivity**

Objectivity in community-based environmental groups has also been identified as a significant short-coming of any activity undertaken by citizen volunteers. Community groups with a clear activism component in their mandates risk rendering their data invalid

when it is perceived as being used to politicize an issue or as biased in data collection due to volunteer perceptions (Stadel & Nelson, 1995). Some activist-driven community-based environmental groups have been shown to underanalyze the raw data before publicizing the problem, resulting in further strain in the relationship with decision making bodies, such as government departments, elected officials and the general public (Stokes *et al.*, 1989).

#### **1.5.4. Government Responsibilities**

Community-based monitoring groups have also expressed a significant loss in volunteers due to concern over the role of governing bodies. As mentioned in Section 1.2, there have been past miscommunications associated with the perceived roles of government in watershed management. Although this has motivated many citizens to actively pursue community-based monitoring programs to fill the gap resulting from government cutbacks, there has also been a movement of individuals who feel this citizen science is weakening governments even more. Community groups performing unpaid work for the government can be viewed as justifying governmental cuts to water monitoring programs (Craig *et al.*, 1995; Scott & Herman, 1995). This has the potential to fragment the goals of a community in regard to environmental conservation.

In addition, resentment of community volunteers has occurred within government agencies and continues to occur with the aforementioned fiscal cutbacks occurring at all levels of government. Community groups have been viewed by government staff as an unpaid replacement for trained, scientific professionals. Additionally, government staff has expressed concern with funds being granted to community groups based on regional and political favoritism and with disregard for the specific needs of the government departments. These attitudes have resulted in a noticeable strain on government-

community group interactions and are not in the best interests of salmon habitat protection (Rosenau & Angelo, 2001; Yarnell & Gayton, 2003).

### **1.5.5 Costs**

The costs of monitoring are often internalized by the volunteers engaged in projects. Volunteers carrying out stream-based monitoring often have to travel to remote locations throughout their region. This results in extended car use and the costs of gas and vehicle wear are often not reimbursed by the group overseeing the monitoring (Morton, 2006). Additionally, some volunteers provide their own equipment and supplies for monitoring and restoration activities, including gloves and buckets. These costs are generally not included in project budgets and often volunteers are not aware of the ability to include these costs in applications for funding grants. These costs represent a considerable contribution by each volunteer over the span of a monitoring year and can lead to a loss of volunteers within the monitoring organization as these costs mount (Donald, 1997; Lopez & Dates, 1998).

### **1.6 Types of Monitoring in Stream Ecosystems**

A comprehensive view of monitoring approaches requires an assessment of indicators of ecosystem health. Stream ecosystem indicators fall into three main categories: physical, chemical and biological (Lopez & Dates, 1998; Spellerberg, 2005).

Physical indicators encompass the physical attributes of a stream ecosystem, including stream channel, flow, boundaries and all riparian habitat affected by the conditions of the system (Lopez & Dates, 1998). Physical indicators are generally most popular in visual assessments of stream ecosystems. These include the assessment of riparian vegetation, waterway obstruction and presence of woody debris (Phipps, 2007).

Chemical indicators used by community monitoring groups involve concentrations of chemicals in the water body under investigation. Samples are collected and analyzed for the presence of specific chemicals that can indicate the status of ecosystem health (Lopez & Dates, 1998).

Biological indicators are the most widely used indicators for community-based monitoring programs, as well as the best method to assess overall ecosystem health (Lopez & Dates, 1998). Used predominantly to assess population numbers, species health and ecological functions of the system in question, biological indicators can indicate changes not only in the chemical condition of the ecosystem but also the physical composition of the surrounding landscape (Lopez & Dates, 1998). Indicators used in this component of monitoring include, but are not limited to, species and numbers of macro-invertebrates, aquatic plants, algae, plankton and fishes. The use of fish species for monitoring programs is a popular approach. These larger aquatic organisms can easily become a species indicator group, whose appearance and abundance in the ecosystem can be directly correlated with environmental degradation and can be used for monitoring multiple measures of ecosystem change and biotic integrity, including community productivity, abundance of exotic species, species diversity and species richness (Environment Canada, 1999; Craig *et al.*, 2003; Jorgensen *et al.*, 2005). Biological indicators were chosen for the purposes of this research for their broad applicability and the minimal amount of training required by volunteers to begin the monitoring process. Additionally, biological monitoring offers the most hands on approach to monitoring, with an added bonus of engaging volunteers in interactions with the natural environment.

## **1.7 Organizations Involved in Community-Based Monitoring in British Columbia**

Salmon monitoring and assessment in B.C. has a wide scope of activities due to the indirect and direct support provided by municipal, provincial and federal governments. All have provided resources both directly and indirectly to groups undertaking monitoring within their regulatory and legislative jurisdictions, leading to a diversity of the types groups operating in regions across B.C. (Pinkerton, 1991; Morton, 2007; Rutherford, 2007).

Paish (1999) outlined the various types of community groups that are involved in monitoring and restoration of fish habitat in British Columbia. This classification not only provides a means to assess the type of activity being undertaken by community-based groups, but it also enabled him to quantify the scale of monitoring being undertaken in the province. Furthermore, it demonstrates the diversity of community-based environmental monitoring organizations operating in British Columbia. For the purposes of this study, the three of levels of community involvement addressed in this research are detailed below.

### **1.7.1 Level 1: Streamkeepers, enhancement societies**

This level represents the smaller-scale organizations operating within a specific site that has been earmarked for monitoring activities. Generally, activities undertaken are on a single stream and are very focused in the nature of activity (Paish, 1999; Yarnell & Gayton, 2003).

### **1.7.2 Level 2: Streamkeepers, enhancement societies, naturalist groups**

This level of community involvement broadens the geographical scope of their monitoring and assessment projects. Generally, projects focus on a watershed scale and

include stream tributaries. Additionally, groups focus on how stream habitats link with the local community. This level has a need for greater numbers of volunteers than Level 1 and has an inherent need for network partners in achieving their goals (Paish, 1999; Yarnell & Gayton, 2003).

### **1.7.3 Level 3: Well established groups and advocacy organizations**

Well established community groups are those that have a large membership and evolved from a Level 1 or Level 2 status as more experience in the field has been gained. These groups also employ an ecosystems based approach at a watershed scale, however included in their mandates is a clear advocacy role where fish habitat is involved (Paish, 1999; Yarnell & Gayton, 2003).

These three types of groups constitute most of the community-based environmental monitoring and restoration organizations on Vancouver Island. This research contacted a mix of Level 1, 2 and 3 organizations in the region with varying degrees of experience. Excellent groups were represented by two of each of the levels, while mediocre groups were comprised of two Level 1 organizations, one Level 2 organization and one Level 3 organization.

## **1.8 Area of Study**

All community-based environmental monitoring organizations contacted are located on southern and central Vancouver Island, British Columbia, Canada. Research attempted to include organizations operating across Vancouver Island, but was unable to include organizations north of Port McNeill (Figure 3).



**Figure 3** Map of Vancouver Island, British Columbia. The map represents the geographical extent of community-based environmental monitoring groups participating in this study. (Source: DFO MAPSTER, 2007)

OHEB is an agency formed and directed under DFO with a principal mandate to protect and restore fish habitat as well as to provide support for community groups, involving federally employed community advisors to liaise between the public and the Government of Canada. It should be noted that the partnership between community groups and DFO is not exclusive and many of the same groups are currently involved in working with developers, industry and other private and public sectors to ensure protection of stream resources in the region (Day & Cantwell, 1998). Each of the community-based groups acting under the guidance of the DFO community advisor restricts their activities to distinct geographical areas, using watershed hydrology to

delineate the boundaries of any monitoring that is undertaken (Chicoine, 1996; DFO, 2006). Volunteer community-based organizations involved in monitoring in the area largely comprise individuals from the surrounding community with varying degrees of experience in water quality or wildlife habitat monitoring and assessment (Morton, 2006).

All of the community groups participating in this study share a common goal of habitat protection and enhancement for the purposes of rejuvenation of native salmon stocks and habitat preservation. Included in these goals are programs established for the specific needs of each geographical area, including the management of natural resources, habitat restoration, habitat assessment, and stream monitoring. Furthermore, the jurisdiction of many of these groups involves stream stewardship, including the development and delivery of public education programs.

Note that the organizations contacted are described collectively, with specific traits and characteristics of monitoring organizations distinguished throughout this report. Focusing discussion on specific community groups will be necessary to illustrate points and provide greater detail on the indicators studied for the purposes of this research. Note also that to respect the privacy of all participants, subjects are purposely not identified in this report.

## **2.0 Research Design**

This section outlines the methods employed to identify and assess indicators of organizational success of groups undertaking community-based environmental monitoring in streams on Vancouver Island, British Columbia, Canada. This study is based on the experiences and work done by citizens and professionals involved in community-based environmental monitoring, and uses a case study approach. The case

study chosen for the purposes of this research is the community groups operating under the direction of OHEB within DFO.

This study was divided into two parts. Firstly, information on each of the community groups undertaking salmon assessment and habitat monitoring was obtained from the community advisor of OHEB and from the DFO database on community involvement. Secondly, this study aimed to examine the procedures and decisions made by community groups when undertaking monitoring activities. Note that this study is an exploratory study of successful traits of community-based environmental monitoring organizations undertaking salmon assessment on Vancouver Island and as such, should be viewed as a springboard for future studies.

Semi- structured interviews using an open ended method of questioning was the preferred method of obtaining information. Interview procedures and questions are outlined later in this section.

## **2.1 Selection of Community Groups, Monitoring Projects and Respondents**

Community groups operating under OHEB were selected through purposive sampling from a preliminary study using both practical and strategic qualitative criteria. Respondents were identified through consultation with the project coordinators at OHEB's regional offices. These coordinators, referred to in this study as community advisors, were interviewed generally to assess suitability of the groups' projects to the purposes of the research. Through this dialogue, the community advisor (CA) identified community groups that were best suited to be respondents, the determining factor being regularity of reporting. This method of participant selection qualifies as purposive

sampling as the community advisor provided information that ensured respondents represented this criteria (Berg, 2004).

Organizations also had to 1) comply with the researcher's definition of community-based environmental monitoring, a process in which citizens and citizen led groups participate in the long-term monitoring of selected species, species habitats and ecosystem processes with the goal of improving natural resource management strategies (Yarnell & Gayton, 2003; Pollock & Whitelaw, 2005); 2) be located on Vancouver Island; and 3) be involved in at least one project involving salmon assessment and/or habitat monitoring in stream ecosystems. Level 1, 2 and 3 community-based monitoring groups were also selected using snowball sampling techniques, with selection also based on their alignment with governmental initiatives and government led funding in their specific region. Snowball sampling involves using existing participants to identify other organizations operating in the region that may not be immediately known, and also can be used to gauge the relationship among groups (Nardi, 2003; Berg 2007). Additionally, scientists, government officials, and members of local conservation authorities were included in this research to provide additional background information on community-based environmental monitoring in jurisdictions in B.C and in Ontario.

Stream ecosystem monitoring was selected for the purposes of this report as it is one of the most common projects that can involve communities and one that elicits widespread public concern. The selection of groups involved in monitoring in partnership with the OHEB also allowed for the possibility to observe any differences in the monitoring processes being undertaken by individual community groups.

For the purposes of this study, six of the best groups that report monitoring data and four mediocre groups that report data were identified to allow comparisons of the

monitoring process between community groups. CAs were asked to distinguish between “excellent” and “mediocre” reporting among community groups. “Excellent” groups were defined as those reporting results on time in an electronic format that met or exceeded what was agreed to by the group and the CA at the onset of the project (Peters, 2007; Rutherford, 2007). Mediocre groups were defined as those groups that reported results on an infrequent basis, and that did not comply with the reporting requirements of DFO’s CAs. This designation was used to provide a general distinction between groups to identify differences in monitoring processes.

## **2.2 Interviews**

Semi-structured interviews were employed when contacting CAs, environmental non-governmental organizations (ENGOs) and community-based environmental monitoring and assessment organizations. This method was chosen as it encourages dialogue between interviewer and interviewee and drew out personal experiences on community-based environmental monitoring in local stream ecosystems (Berg, 2007). This was preferable to a set line of questioning as it allowed for greater participant comfort and fewer directional constraints in the interview. Interviews were guided by specific subject areas, including environmental governance, project partnerships and stakeholder involvement, and scope and awareness of projects and programs in the community.

Interviews were conducted with CAs to determine characteristics of environmental monitoring initiatives that were considered integral for successful monitoring and assessment campaigns. From these interviews, a listing of community-based environmental monitoring groups was established. Once a specific set of community

groups was established, the same interview process was employed using subject areas adapted from O'Neill *et al.* (1994) and Whitelaw (2002). These interviews differed from the initial interviews in that they built on the information already collected and guided the research into identifying more specific reasons behind differences in monitoring processes (Appendix 1). In addition to the questions used for project coordinators, changes were made through the guided questions and were presented to community groups. Questions for community groups related to motivation of volunteers, training, project financing, communication, roles and responsibilities of volunteer, community engagement, and follow-up on completed projects and were based on a previous literature review.

A more detailed questionnaire was given to the community groups and to specific project leaders according to their categorization as either excellent or mediocre as identified by project coordinators (Appendix 2).

The information collected through interviews was used to provide an understanding of how community-based monitoring groups differed in their approach to monitoring stream ecosystems. It was also useful in determining how participants interpreted the success of their own programs and projects. Throughout this report, participant quotations are used to confirm, reinforce, or disprove current indicators of success. These quotations are also used for the development of any new indicators for use by community-based stream monitoring group that may arise through the qualitative research for this report.

All community groups were assessed using the same semi-structured interview approach to determine similarities in organizational structure, thus evaluating the validity of indicators for community organizational success. Furthermore, through interviews

with individual community groups, any additional indicators that could be used to improve the development and delivery of community based environmental monitoring organizations were identified and reported in the results.

The interview questions were validated by the thesis supervisor and the General Research and Ethics Board (GREB) at Queen's University (Appendix 3). These parties assessed that the interview process was fair and addressed the following general research question:

*What are the factors that contribute to successful community-based environmental monitoring in stream ecosystems and can indicators be used as an assessment tool for natural resource management?*

Recruitment of interviewees and data gathering began upon agreement by the above parties that the research approach was acceptable.

For the purposes of this research, it was assumed that community-based environmental monitoring is inherently positive and beneficial to ecosystem management and community development. As such, questions were framed with this in mind.

### **2.3 Interview Analysis**

Interview results from CAs and project coordinators were transcribed and coded to assess the presence of trends in responses. Information obtained from CAs was used to supplement academic sources identified in the literature review as well as to provide direction for questioning individual groups. Information from community groups was also used to identify and develop indicators relating to, but not exclusive to, organizational structure.

The answers of community advisors and project leaders were documented in a matrix compiled using Microsoft Excel. This matrix was then analyzed for item content using a deductive approach (Berg, 2004). Analysis under this approach assesses the similarities and variance among community monitoring groups through categorizing the results obtained through interviews. Categorical patterns were identified using the narrative approach. Patterns were further supported with appropriate literature, and recommendations were made from these findings.

## **2.4 Limitations**

Several potential limitations may have affected the outcome of the research presented in this report. Regardless of the inclusions of any limitations or related factors, the research provided should still represent a good basis to evaluate and identify organizational indicators or community-based monitoring groups operating in stream ecosystems.

Firstly, groups contacted for the purposes of interviewing had the potential to be automatically interpreted as successful simply because they still exist and were contacted for the purposes of this research. As this research also aims to address the development of indicators to ensure that more groups survive the long term, it necessitates the inclusion of failed groups to discern differences in group organizational structure. As failed organizations are substantially more difficult to locate upon disbandment, mediocre reporters were included instead.

Secondly, questions could be interpreted differently by community group respondents. During the interview process, clarification of questions was offered only when requested by community-based environmental organizations. Minimal guidance or

prompting was undertaken by the interviewer to ensure a minimal bias. For example, when discussing the follow-up of projects by community groups, “identifiable commitment” was interpreted by some as financial support and by others as a stable volunteer base.

Thirdly, time constraints for this project limited the possibility for contacting more groups, analyzing and interpreting undertaking analysis of results and providing recommendations.

Finally, the number of community groups was relatively small for statistical analysis. An attempt was made at contacting all project leaders in the geographical area of study, however a larger number of participants could not be obtained (Nardi, 2003).

### **3.0 Results and Discussion**

Through the identification of these indicators it was then possible to select those that would be employed on a smaller scale, specifically stream monitoring and restoration for the purposes of salmon stock assessment.

Although there exist many more indicators, the following were deemed most appropriate due to their frequency in the literature and their occurrence in conversations with DFO community advisors (Table 1). Indicators that were not identified through the literature review but were deemed by the researcher to be important components of community-based monitoring success are highlighted throughout the sections.

<b>Indicator</b>	<b>Indicator evaluation through literature and interviews</b>
Funding	<ul style="list-style-type: none"> <li>• Presence of government funding for operational and project costs.</li> <li>• Additional fundraising activities being undertaken by groups to augment government funding.</li> </ul>
Training	<ul style="list-style-type: none"> <li>• Mandatory training in methods, equipment and sampling techniques administered before volunteers begin monitoring activities.</li> <li>• Training refresher courses to update skills and techniques of volunteers to ensure reliable and consistent data.</li> </ul>
Standardization of methods	<ul style="list-style-type: none"> <li>• Standardized methods and protocols for data collection and interpretation to ensure consistency in the information collected and the usability of data by outside organizations (e.g. DFO, community-based organizations).</li> <li>• Reporting done in a timely and regular basis to legitimize data.</li> </ul>
Communication strategies	<ul style="list-style-type: none"> <li>• Internal strategies for timely and comprehensive communication of information to volunteer base.</li> <li>• External communication strategies for community outreach and stakeholder identification.</li> <li>• Media relations used for communicating results and public outreach activities.</li> <li>• Networks and partnerships in place for information and data sharing among community-based environmental monitoring and assessment organizations in the region.</li> </ul>
Community programming	<ul style="list-style-type: none"> <li>• Educational programs in schools for stewardship initiatives.</li> <li>• Community programs to include a broader scope of participants, including adults and families to increase awareness.</li> </ul>
Goals and roles of the organization	<ul style="list-style-type: none"> <li>• Clear goals outlined in the mandate of the organization or clearly stated at the onset of a project.</li> <li>• Roles of volunteers are set at the beginning of a project, but can be dynamic in nature. Roles evolve as the role of the volunteers becomes rooted in the organization.</li> </ul>
Project follow-up	<ul style="list-style-type: none"> <li>• Ongoing follow-up on completed projects to identify changes in habitat quality and/or species populations.</li> </ul>

**Table 1** Summary of indicators used to assess community-based environmental monitoring organizations on Vancouver Island, British Columbia.

### 3.1 Funding

All ten of the interviewees took advantage of the DFO funding available to them through their community advisors on an annual basis (Table 2).

<i>Indicator Assessed</i>	<i>Number of positive responses (E)</i> <i>n = 6</i>	<i>Number of positive responses (M)</i> <i>n = 4</i>	<i>Interviewees</i>
Use of government and foundation grants	6 (100%)	4 (100%)	E1, E2, E3, E4, E5, E6, M1, M2, M3, M4
Fundraising activities	4 (66%)	1 (25%)	E1, E2, E3, E4, E6, M2

**Table 2** Indicators of adequate funding of projects by community-based organizations on Vancouver Island, British Columbia, Abbreviations: E = excellent; M = mediocre

All groups also indicated that this funding was critical in ensuring that their groups remained operational, with telephones, lights and other basic amenities. It was, however, the groups identified as “excellent” prior to interviews that clearly demonstrated the ability to secure a greater amount of funding in addition to that provided by DFO. Four out of six of the groups continuously sought additional funding in the community to supplement government and foundation grants. As expected, groups that were designated as “mediocre” did not use other community partnerships to their full potential in achieving funding for the fiscal year, with only one out of the four groups stating they engaged in external fundraising. For example, M1 had lost several sources of annual funding when a local forestry company terminated their community grant program and did not engage in any community fundraising initiatives. Any future projects and even existing projects could then not be accomplished and the group found themselves struggling to maintain a visible presence in the community and in undertaking any new monitoring activities on streams in their watershed. M1 stated the group’s desire to expand into other areas, but due to limited finances, they undertook only the minimal amount of monitoring as required through their DFO grant (Interviewee M1, 2007).

In all instances, groups also benefited from indirect funding from government agencies involved in the monitoring process. Particularly, those community groups aligned with OHEB can access resources that other groups would otherwise have to pay for. An example of this is a laboratory technician to analyze samples or species in greater detail and to identify trends in monitoring results. This is of immense benefit to groups in that it enables resources to be invested in other aspects of the project, and provides a substantial amount of raw data to DFO with minimal departmental expenditures for data collection at a large geographical scale (Peterson, 2005).

Funding represents an integral component of the organizational structure of groups monitoring streams and should be considered first and foremost when developing projects. The findings in the literature review correlate with the results found through community group interviews. Without adequate resources, community-based groups are unable to carry out any of the activities necessary for data collection and prolonged monitoring campaigns. Interviewees identified the following uses of funding: project delivery, professional training, monitoring and restoration equipment, restoration services (e.g. backhoes, construction) and administrative costs.

The definition of “adequate funding” for the purposes of this research is funding that came from a variety of sources, including governments, foundations, private donors and fundraising activities. As defined in the literature, adequate funding is critical in ensuring the longevity of community-based monitoring and can also be accredited to ensuring volunteer commitment well into the future. As an example, volunteers who initially join an organization can grow frustrated and eventually depart monitoring activities when groups constantly struggle to maintain funding to undertake projects, hire any necessary staff and secure finances to maintain the organization. This type of activity can

overshadow the initial purpose of the organization, which is habitat conservation and environmental assessment (Rosenau & Angelo, 2001).

Funding is also critical in ensuring that the information obtained by community groups remains useful and up to date. Groups who engage in assessment and enhancement need to have up to date and functional equipment as well as the funds to engage one or more paid individuals either to fill in any information gaps, or to analyze the information as required (Dehn & Henry, 1995). This has been demonstrated by several groups contacted for this research, in that where community expertise is lacking, experts are hired from outside the organization to complete the work. This use of funds is seen as a measure not only to free volunteer time for ground-level monitoring activities, but also to give the project and organization a greater degree of credibility among governments, communities and network partners. Of significant interest is that community groups undertaking fundraising are accessing funds that are not accessible by most levels of government (Rosenau & Angelo, 2001; Pollock & Whitelaw, 2005). Governments are unable to solicit citizens for donations to a monitoring campaign but through supporting community-based groups through government grants, monies can promote a greater breadth of activities in a community. For example, under the direction of OHEB, groups are able to apply on an annual basis for project specific funding, however the funding available is relatively small, ranging from \$500 to \$6000 per group per project (Rutherford, 2007). Funds are levied as needed and community groups are required to submit an application to their CA. Upon project completion, groups are required to submit a project report and receipts for all costs accrued throughout the project to ensure financial accountability. Furthermore, one of the conditions of this funding is that groups are then responsible for securing any remaining funds for the

project. Groups are encouraged to accomplish this through partnerships with private businesses, fundraising drives and membership fees (Pinkerton, 1991; Whitelaw *et al.*, 2003; Morton, 2006).

### **3.1.1. Fundraising**

An important distinction that emerged out of the data was that those groups designated as “excellent” tended to be more involved in fundraising activities. Fundraising for community-based groups involves proactively raising financial support within the community for specific projects or for the organization. It can include soliciting private businesses, citizens and the general community for project specific donations or for donations to support the organization. Five of the six excellent groups undertook fundraising activities on a regular basis, while only one of the mediocre groups interviewed stated that any fundraising was being done in their respective region.

### **3.1.2. Recommendations for improvements of funding and fundraising initiatives**

Groups involved in community-based monitoring should be provided with adequate information on obtaining funding for administrative and operational needs. Interviewees in both new and existing groups were unaware of the resources available to them, and the limitations to government grants and funds. The presence of CAs who will provide guidance should be actively promoted as available for use by groups. This role must be spearheaded by DFO and the CAs through the day to day interactions with community groups. Initial engagement in this communication can then be delegated to the community groups through the formation of networks and partnerships in their specific jurisdictions.

An example of organizational inexperience with funds is when groups apply for more than one level of government funding, a process termed ‘fund stacking’, which is often not permitted. When they are discovered “stacking” government grants, they are required to relinquish funds and must then support their projects through fundraising activities (Morton, 2006). This can be a large financial set-back to many organizations just starting and has the potential to discourage further monitoring.

Integral to successful fundraising is the need for community groups to increase their knowledge of regional and provincial designation as “not for profit” organizations. Group E2 benefited greatly with the knowledge of this status. When the need for services arose in their restoration projects, the association requested in kind donations of equipment in exchange for a tax deductible receipt. The promotion of the “not for profit” status has resulted in increased support by local businesses for monitoring and restoration projects in the region (Interviewee E2, 2007). This type of indirect funding has the potential to be of great benefit to all groups operating in Vancouver Island as a cost-saving measure for equipment rentals and usage, and can ensure funds are left for continuous project monitoring and additional projects.

### **3.2 Training**

Training done prior to monitoring ensures the proper identification of species and/or natural features, knowledge of equipment and an understanding of why monitoring is being undertaken in a particular area. This section aims to discuss the importance of the presence of training for volunteers and any traits related to training within the organization. Specifics on training will not be addressed in this section as training procedures can differ among groups, depending on the type of data they are collecting

and its intended uses. Instead, this section will gauge the willingness of groups to provide training to their volunteers.

Five of the six excellent groups expressed that training was an important aspect of their organizational structure, with volunteers participating in at least one of a variety of training activities organized by the community-based group (Table 3). In contrast, only half of the mediocre groups surveyed engaged their volunteers in environmental training techniques opting instead to provide verbal directions or simply a worksheet where volunteers are required to collect data with no context behind the information they are required to gather.

<i>Indicator Assessed</i>	<i>Number of positive responses (E)</i> <i>n = 6</i>	<i>Number of positive responses (M)</i> <i>n = 4</i>	<i>Interviewees</i>
Use of training	5 (83%)	2 (50%)	E1, E2, E3, E4, E6, M2, M4
Presence of training refreshers	5 (83%)	1 (25%)	E1, E2, E3, E4, E6, M4

**Table 3** Indicators of successful training attributes undertaken by community-based organizations on Vancouver Island, British Columbia  
Abbreviations: E = excellent; M = mediocre

Adequate training for volunteers is extensively highlighted in the literature as an indicator of organizational success among community-based environmental monitoring groups (O'Neill *et al.*, 1995; McLaughlin & Hilts, 1999; Fore *et al.*, 2001; Whitelaw *et al.*, 2003). Training has also been identified as a tool to maintain volunteer interest in a particular project through the acquisition of new skills.

Training of volunteers has several components that through this research appear to be indicators of organizational success among community-based monitoring groups on Vancouver Island. These components include, but are not limited to, expert training and on site training of volunteers and volunteer group cohesion.

### **3.2.1 Expert training**

Expert training is defined as information administered by an expert or technical specialist, such as a government official, biologist or ENGO official and can be used not only to ensure that proper monitoring techniques are carried out, but also as an assessment of the immediate skill level of participants (O'Neill *et al.*, 1995; Whitelaw *et al.*, 2003). Information from these experts can come in the form of hiring them as consultants, organizing workshops for volunteers and actively seeking out instructional manuals pertaining to the specifics of their monitoring campaigns (Lopez & Dates, 1998). The benefits of using experts include ensuring that data are reputable and scientifically sound (as discussed in section 3.0) and broadening understanding of the environmental issue at hand.

Three of the excellent groups cited expert training to be integral to their programs, with the most common sources of information coming from the community advisors or from one of several well established salmon federations, such as Pacific Streamkeepers Federation, located in the province of British Columbia and servicing all B.C. community-based environmental monitoring organizations.

### **3.2.2 On site training**

A more commonly used procedure by groups operating on Vancouver Island is to complete on site training in sampling and assessment methodologies. This requires supervision of volunteers on site and generally evolves into a train-the-trainer approach to necessary skill requirements. In this instance, groups of volunteers are always accompanied by a member of the organization who has completed the proper training and is willing to pass this information along to one or more members of the group. This approach seems to have been used as a substitute for mandatory training by all groups

involved in the study and can be interpreted as beneficial in ensuring volunteer commitment to projects, as it does not require extra time commitment by volunteers to participate in monitoring and restoration activities.

### **3.2.3. Group cohesion**

Successful groups also indicated the importance of training activities in creating a bond among volunteers and making the event more enjoyable for all those involved. Social networks not only provide a better understanding of the training material and all environmental issues surrounding the site they are monitoring, but are also important in identifying leaders among volunteers. These leaders can then be approached to lead training activities among new volunteers

### **3.2.4 Training refreshers**

Updating skills that were acquired through initial volunteerism with a community-based environmental group has been identified through the literature as an important component in securing successful and scientifically sound data as well as continuous volunteer support of local projects (Heiman, 1997). This was further reflected through interviews with community groups. None of the groups identified as mediocre offered a training refresher course for volunteers, nor did they encourage volunteers to seek out other more experienced members of the group to ensure proper methods were being followed. In fact, the small amount of training that was offered once volunteers entered the project was often only a one time event. M2 stated that "...the training is done on the job and basically for the first few times we show them how its done and [...] once they know how to use the equipment, they are on their own."

### **3.2.5 Recommendations for improvements in training procedures**

After a review of the literature and interviews with government officials, mandatory training was identified as a characteristic of groups undertaking successful monitoring campaigns. However, through interviews with community groups on Vancouver Island, it was found that both the excellent groups and mediocre groups had training available, but volunteers in both these groups were not required to complete it before going into the field to collect data. Although the small number of groups interviewed would indicate that further research is needed into this indicator, it also indicated that the group may be more successful and have a greater impact if mandatory training was administered directly to their volunteer base. Before any definitive conclusions can be made, an assessment of the training capabilities of all groups located on Vancouver Island should be done to ensure that this is ubiquitous among groups.

Based on an emphasis by the literature and interviews with excellent groups, the implementation of training programs for all community-based groups would not only increase the reputations of community-based groups, but would also enable volunteers to develop new skills, whether they be in learning how to use new equipment or working with the organization to develop modules for monitoring procedures (Morton, 2006). Of particular significance is the value of engaging volunteers in the development of new training techniques and protocols. As an example, the Pacific Streamkeepers Federation (PSKF) currently has a series of manuals and modules available to community groups involved in monitoring and assessment of salmon stocks, however these are not used by all groups in a consistent manner. Groups should explore adopting similar manuals or work collaboratively to develop training protocols that can be applied to all groups working towards the common goal of revitalizing viable salmon populations.

Standardization of training methods will heighten social and scientific acceptance of data collection by citizens, and allow results to be applied at a much larger scale on Vancouver Island. This standardization of methods for training will be discussed in section 3.3, however its impact should be addressed in the context of training volunteers.

### **3.3 Standardization of methods and monitoring protocols**

The standardization of methods and protocols by community-based organizations is a component that should occur in the development stages of projects, and is the basis for all monitoring activities undertaken in an area of study (Vaughan *et al.*, 2003).

Standardization of methods not only ensures that data collection and reporting remains consistent, reputable and accurate among volunteers, but also facilitates the ease with which groups can share information among other organizations in the region (Whitelaw *et al.*, 2002; Yarnell & Gayton, 2003; Pollock & Whitelaw, 2005). Standardized methods can be defined as a set of standard methodologies and tools for use in projects of similar scope to provide comparable data at a broad geographical scale in a timely manner, and should be easily incorporated into the monitoring plans of community-based organizations. Included in these methodologies are field collection methods, lab protocols and data management systems (Craig *et al.*, 1995; Sharpe *et al.*, 2000; Vaughan *et al.*, 2001).

Five out of six of the excellent groups stated that standardization of methods and protocols occurred at all levels and for all projects, and were part of the mandate of the organization (Table 4.0). In contrast, only two out of four mediocre groups incorporated standardized methods into project methodologies. All groups who indicated the presence of standardized methods used them to ensure that data could be usable by DFO officials

and partners, and stressed that their incorporation of a standard set of monitoring protocols was to ensure that their actions were making a positive impact on salmon enhancement. The lack of standard methods or protocols is problematic when analyzing the methods undertaken by mediocre groups contacted for this study. Group M1 and M3 did not ensure that volunteers used the same collection methods between sites, with M1 even stating that they were recording data on scrap paper and that there was no filing system in place (Interviewee M1, 2007).

<i>Indicator Assessed</i>	<i>Number of positive responses (E) n = 6</i>	<i>Number of positive responses (M) n = 4</i>	<i>Interviewees</i>
Standardization of methods and protocols	5 (83%)	2 (50%)	E1, E2, E3, E4, E6, M2, M3
Data reporting	5 (83%)	1 (25%)	E1, E2, E3, E4, E6, M1

**Table 4** Indicators of standardized methods and successful data reporting undertaken by community-based organizations on Vancouver Island, British Columbia  
Abbreviations: E = excellent ; M = mediocre

Of particular significance to groups working on salmon stock assessment is the standardization of field collection methods. This should be done to assure that data collected among different sites is done uniformly, particularly when quantifiable data are the main goal of organizations in monitoring and assessment activities (Lajeunesse *et al.*, 1995). Data collected using different methods have not been demonstrated as being either reliable or accurate by either the scientific or public communities, where “reliable” means the ability to reproduce results and “accurate” refers to the ability of groups to establish trends and patterns in salmon populations (Au *et al.*, 2000). As previously discussed in Section 3.2, this frees valuable time and resources for the more senior

members of the organization and enables the development of a train- the-trainer approach to monitoring and assessment.

One long-term benefit in the standardization of monitoring and assessment methods is that groups are able to monitor long term trends and track any changes in environmental conditions that could be impacting salmon stocks in their jurisdiction (MacDonald *et al.*, 2000; Vaughan *et al.*, 2001). Once these changes have been identified, they can easily be compared to data sets of other organizations on Vancouver Island to determine the extent of the environmental changes as well as their effects on salmon numbers. Once trends have been established, organizations can make decisions on the direction of future projects and can undertake additional collaboration with other organizations to ensure the best management and monitoring strategies are applied using the appropriate data. Standardized methodologies are positively related to networks and partnerships among groups as it is unrealistic to share information, particularly raw data, that has not been collected using the same protocols and as such could be unreliable and unusable for resource management strategies. As a result, OHEB managers would then be required to use their resources to recollect data, reducing the resources that could be allocated to community groups in the region through project grants. DFO recollection of data is also worrisome as salmon migration and spawning occurs only in the fall and spring respectively (DFO OHEB, 2007). It is important that proper monitoring and assessment activity be undertaken at these peak times to maximize the quality of data collected. Should estimations of salmon populations be improperly collected and management decisions be made using inaccurate data, the impacts on an already stressed species could be devastating. For example, in response to overestimation of salmon

populations, organizations may scale back their activities and subsequently overlook major threats to streams.

### **3.3.1 Reporting data**

Few references are made to data reporting in the literature, making the designation of its importance to community-based environmental monitoring difficult. However its mention in interviews by both DFO CAs and community groups requires that it is discussed in some form in this study. Thus, reporting of findings in the data will be addressed in greater depth in this section as it relates to the collection of reliable and accurate raw data. Additionally, reporting data as it pertains to the specifics of this study will entail reporting to the volunteer base and to the community at large.

Reporting results also is directly related to communication strategies of monitoring organizations. Excellent groups demonstrated a greater ability to report results to the appropriate DFO staff, the volunteers and the community at large. Citing organizational policies of open sharing of information and community education, excellent groups posted results online to ensure that results were available to whoever was interested in them. All but one of the excellent groups preferred to analyze raw data for trends or significant findings that have come from monitoring activities and post this information in graph or tabular form rather than have raw data as the only information available online. Group E4 was the only group that posted raw data on their website, stating that it is beneficial for other groups wishing to substantiate any funding applications or to confirm some of their own monitoring results. Mediocre groups did not publish analyzed data or raw data on their websites.

Additionally, reporting data relates to communication strategies through the use of inclusive language. Language that is accessible to all comprehension levels ensures a

broader understanding of salmon enhancement in the region, and can aid in encouraging volunteers to participate with the organization. Raw data, although useful, can be difficult to interpret. The use of graphs and tables, or a simple break down of information found through monitoring activities can make the information substantially more accessible and can be a powerful motivating tool in recruiting new volunteers if posted on a widely available outlet, such as an organization's website. Five of six excellent groups posted results on their website on a regular basis. The one organization that indicated that they did not post on a website indicated instead that they preferred to disseminate information through paper mail outs.

Effective data reporting is dependent on the application of standardized methods, as the data collected must first be acquired in a reliable manner before it is interpreted and made accessible (Stadel & Nelson, 1995). Once results have been compiled, it is necessary to communicate these results to the volunteer base and to the community to achieve any measure of project support, and to promote environmental stewardship in the region. As such, data collection must be done on a regular and timely basis to ensure that any reporting can withstand criticism on how and why data are being collected. Under the direction of the CA, DFO collects data and publishes the necessary information in the form of reports, fact sheets and newsletters (Peters, 2007).

### **3.3.2 Recommendations for improvements in data reporting and the application of standardized methodologies**

Standardized methodologies should be mandatory for all projects undertaken by community-based organizations. Additionally, not only should mandatory standardization be done throughout a project, it should also be applied to all projects occurring under the direction of the community-based environmental monitoring

organization to ensure that data collected will consistently be available and of use for government organizations, members of the public and other community-based organizations.

Methodologies that are adopted should be accessible to people with a variety of skill levels while maintaining scientific rigor (Au *et al.*, 2000). As previously mentioned, volunteers involved in salmon stock monitoring and assessment come from a diversity of backgrounds and will have a variety of comprehension levels. Thus, broad brush understanding of methods should be employed through the use of lay language when establishing project methodologies, and simple data collection techniques should be the basis of each field collection outing.

Standardized data management systems should be a priority for groups already using standardized field collection methods. This is another way to ensure that information sharing can occur at a broad scale across Vancouver Island as it will compact all data into a centralized database that can be easily accessed by those wishing to use it. Additionally, standardized databases would decrease the amount of time spent on the organization and storage of data within a community group, and would ensure that a simple and easy to understand system could be set in place.

The Ecological Monitoring and Assessment Network (EMAN), under the direction of Environment Canada, has developed a standard approach to monitoring ecosystem change that fits the needs of community groups, government and all other levels of ecosystem managers (Craig *et al.*, 1995). Using this approach as a model, community-based organizations could collaborate to create a set of methods specific to the goals of salmon stock monitoring and assessment. Not only would this ensure that data collected on Vancouver Island are scientifically sound, but it would also create opportunities for

partnerships among groups. This in turn would strengthen the contributions of community-based organizations to environmental stewardship in the region through the promotion of a united front of organizations with a common goal of salmon protection. Additionally, the PSKF has created comprehensive modules for biological monitoring techniques being undertaken in B.C. streams. These modules could also become the basis for further collaboration on appropriate methods for groups undertaking chemical, physical and biological monitoring that expands beyond the scope of macrobenthic organisms currently covered by PSKF.

Finally, organizations involved in salmon assessment and monitoring on Vancouver Island should develop and maintain a website for disseminating information on monitoring results. The design and development of websites is another area that could rely on networks and partnerships to provide guidance, or it could be coordinated under the direction of OHEB. Additionally, it could be included in the development of modules specific for media communications. An up to date and functioning website appears to be an integral component in communication strategies, networks and partnership as well as reporting data, and should be taken into consideration by existing and new groups operating in the region.

### **3.4 Communication Strategies**

Communication is critical in ensuring community-based environmental monitoring groups deliver comprehensive and informative results of their projects not only to the community, but also to their volunteers and to past and future funding agencies. Communication entails making the aforementioned parties aware of proposed monitoring projects and all subsequent findings, and using the appropriate outlets to do so. Indeed,

the inclusion of the organization's networks and groups in the cycle of communication can also be crucial to the sustainability of any salmon stock assessment project in a given community. The elements of communication to be discussed in this section include internal and external communication, community consultation, the use of media resources, and networks and partnerships among other community-based environmental groups. The all encompassing goal of open communication is to encourage a better understanding of salmon stock issues moving towards shared responsibility of management, and working collaboratively towards projects and solutions (MacDonald *et al.*, 2000).

#### **3.4.1 Internal and external communications and community consultation**

Internal and external communication strategies are developed by community groups to provide information on current and proposed monitoring and assessment projects to volunteers and community stakeholders, respectively (Whitelaw *et al.*, 2003; Pollock & Whitelaw, 2005).

All groups contacted for the purposes of this study engaged in monitoring and assessment on Vancouver Island conveyed information to both internal and external players in language that was accessible to all. Raw data was interpreted and presented in lay terms on websites or in newsletters to guarantee an understanding of the issue at all levels, which should be the first goal of any communication strategy (Vaughan, 2001).

Four of the six excellent groups cited the use of both internal and external communication strategies when developing and delivering projects in their region (Table 5). Of utmost importance, the groups presenting any information to the community or volunteers ensured that they did so in a timely manner, so that all parties involved were aware of the most up to date information.

<i>Indicator Assessed</i>	<i>Number of positive responses (E)</i> <i>n=6</i>	<i>Number of positive responses (M)</i> <i>n=4</i>	<i>Interviewees</i>
Presence of Community consultation	4 (66%)	1 (25%)	E2, E3, E4, E6, M2
Presence of Community and volunteer communication	6 (100%)	1 (25%)	E1, E2, E3, E4, E5, E6, M2,
Use of media	5 (83%)	2 (50%)	E1, E2, E3, E4, E5, E6, M1, M4
Presence of networks/partnerships	6 (100%)	2 (50%)	E1, E2, E3, E4, E5, E6, M2, M4

**Table 5** Indicators of successful communication strategies undertaken by community-based organizations on Vancouver Island, British Columbia  
Abbreviations: E = excellent; M = mediocre

It has been widely acknowledged that a timely and accessible dissemination of information leads to the establishment of greater support for adaptive management and environmental stewardship in the region, with volunteers and citizens aware of the decisions being made based on the most recent data collection (Vaughan *et al.*, 2003). These groups were acutely aware of this fact and strove to include this in their mandates. Group E1 cited the use of an electronic and hard copy newsletter that is sent to all members of the organization to communicate findings. This is done on top of publication of information on the group's website. Group E1 stated that they need to "put [the information] out there as much as [they] can" and mail-outs, participation in community events, and the websites were considered the best means to do so (Interviewee E1, 2007). In contrast, mediocre groups were inconsistent in their application of communication strategies, with only M2 engaging in some form of community communication and consultation. Indeed, this inconsistency was amplified as only one of the groups identified any level of commitment to volunteer communication strategies. At the most extreme, group M1 kept the information gathered from monitoring within the board of

directors, who then made all decisions based on this information. It was stated that any required consultation with stakeholders, volunteers and the community at large was left to the regional DFO CA (Interviewee M1, 2007).

Internal communications to the project's volunteer base can aid in the continued support of the project by those currently involved. Through the regular communication of results, volunteers are able to track the progress their actions are making as well as to develop a better understanding of the dynamic nature of environmental issues. This approach leads to the development of two-way communication with project coordinators and volunteers, allowing volunteers to submit feedback and actively participate in the process, promoting a long term learning commitment to the issue (Donald, 1997; Cuthill, 2000). Internal communications also provide an incentive for continued volunteer participation in projects and the organization. Through maintaining an open relationship with the volunteer base, volunteers continuously feel that they are getting something accomplished, particularly when assessment of salmon stock numbers is communicated on a regular basis.

External communication strategies include not only the communication of monitoring and assessment results, but also the presence of a consultation process with the community prior to any environmental activity at a site (Currie-Alder, 2005; Pollock & Whitelaw, 2005; Milne *et al.*, 2006). Before a project can begin, it is important that community groups actively engage any stakeholders that would be affected by any decisions made on the stream, or on the salmon inhabiting the stream. These stakeholders can include among others homeowners with property adjacent to the stream, industry groups using the watershed's water supply, aboriginal groups, commercial salmon fishers and recreational groups. The identification and inclusion of these stakeholders groups has

the potential to increase overall community support of salmon monitoring and assessment programs in the region through continued consultation with those affected by the stream and salmon stock revitalization (Pinkerton, 1991; Brenneis & M'Gonigle, 1992).

Exclusion of stakeholders can result in the community either remaining unaware of the decrease in local stream quality and salmon stock populations, or resentful of a closed door decision-making process on what can be perceived as an issue that should involve the entire community. Stakeholder identification holds the potential for long term support of group activities, and thus sustainable monitoring programs on Vancouver Island.

### **3.4.2 Media**

Media relations are another important tool of communication employed by many groups to relay information relating to specific projects or to fulfill the overall mandate of public outreach by the organization. Community-groups on Vancouver Island have access to a wide variety of media outlets including local newspapers, television, radio and community recreational guides.

Five of the six excellent groups and two of four mediocre groups employed the local media as a means of communicating organizational events and project results to the community (Table 5). The consistency of groups employing this method suggests that good media relations are having an impact on communication strategies on Vancouver Island. Of course, further research into the extent of this impact would be required before it could be concretely stated that the effects are indeed positive. Of particular significance was the use of local recreational guides as a medium of volunteer recruitment and as the general promotion of the organization's projects and mandate. Group E3 cited the use of the recreational guide as an important tool in recruiting adult populations to participate in projects and not to limit their community education program to the school

system (Interviewee E3, 2007). Additionally, Group E5 cited a good relationship with local television stations in promoting projects in the region. Television provides citizens with a visual image of any activity that is being undertaken and also encourages volunteerism once citizens recognize that salmon assessment and stock revitalization is taking place in their own backyards (Interviewee E5, 2007). It should be recognized however, that television media can be equally detrimental to monitoring groups due to the shortness of sound bytes and clips that are required for interest pieces or news stories. Groups need to be able to communicate information in a concise and succinct nature to be effective (Cox, 2006).

Media also can be a cost-effective way of reaching the largest audience possible. Often local newspapers will cover a story of relevance to the community at no cost to the organization, providing publicity. Radio stations and recreation guides also provide advertising and publicity services at nominal fees for community organizations. Although there exists a wide range of media outlets willing to work with community groups, organizations need to be aware of all adequate techniques for conveying their message to the community.

### **3.4.3. Networks and partnerships**

The monitoring and assessment of salmon populations and salmon habitat on Vancouver Island must be a collaborative process, with emphasis placed on partnerships both within the community and among similar organizations in the region (Day & Litke, 1998; Whitelaw, 2002; Prescott-Allen, 2003; Pollock & Whitelaw, 2005). Partnerships allow open sharing of information and a means for groups to maximize social capital and group capacity (EMAN, 2003).

All six excellent groups contacted for this study admitted to sharing information with other organizations and sharing it often (Table 5). All groups stated that information sharing was critical in the promotion of salmon conservation and assessment in the province and all stated that it would be an ongoing process built directly into the mandates of their organizations. Group E4 supported partnerships for sharing data and monitoring information but also for sharing monitoring equipment. The organization purchased multiple units of water quality monitoring equipment and created a “lending library” of technical resources. These resources were openly shared by anyone who was interested in undertaking monitoring or assessment projects (Interviewee E4, 2007).

Mediocre groups were not as clear in the importance of networks and partnerships in the dissemination of information acquired through their activities. Group M4 were aware that information and resource sharing was occurring, but had not yet actively participated in it and provided no examples on how networks occurred in the region (Interviewee M4, 2007). Group M1 explicitly stated that no information was shared to anyone outside of their board of directors, and that they rely on DFO to ensure that any data collected reaches interested parties (Interviewee M1, 2007).

#### **3.4.4 Recommendations for improvements in communication strategies**

Prior to the start of a project, the components of communication should be carefully heeded by community groups interacting with internal and external stakeholders. These components, when applied to the development of a project, can aid in the identification of pertinent stakeholders and can begin the process of emphasizing environmental stewardship in local communities. Stakeholder identification, when done using community consultation and communication, and when effectively using all available media sources, can be significantly more successful through broad brush consultation

tactics. Group E2 used the media to convey a broad understanding of the environmental issue or site of concern, and found that this drew all interested parties into the organization either to volunteer or to actively seek further information. The initial interest by stakeholders then gave the group the opportunity to focus their outreach and tailor communication to the specific needs of the individuals or organization (Interviewee E2, 2007).

The use of media to recruit interest and volunteers should also be explored further by all community-based groups operating on Vancouver Island. Many of the partner federations and government agencies offer adequate scientific support, but do little to educate groups on the importance of using local media sources to the best of their abilities. This is of particular importance as groups with little to no training on media relations not only lose an important outlet for their message, but they risk ineffective and poor coverage of projects, which has the potential for negative impacts on the project. An example of this was seen in group M1, where media coverage was not employed in promoting their organization due to a mistrust of media sources and a lack of understanding of the process involved in media communications. As a result, the interviewee cited poor knowledge of projects by the local community. The development of modules on media communication similar to those offered by PSKF on training and monitoring techniques would be an appropriate short term goal for all parties involved in monitoring and assessment in the region. Additionally, groups should identify one individual to liaise with media organizations on a consistent basis. Delegating this task to one or a select few individuals would eliminate overlap in contact or communication with the media and would allow media relation skills to be developed. Effective media communication skills not only encourage newspapers and other media to contact

organizations, but also improve the reputation of the organization in the community when done by a well-spoken and knowledgeable individual or individuals and on a regular basis.

Transparency in decision making and adequate articulation of the decision-making process to all participants in monitoring and assessment projects was not acknowledged by any of the groups who participated in this study, even though it was a common trend in the literature as being an important component of organizational success (Savan *et al.*, 2004). This is not to imply that there was no transparency or communication of the decisions made by the organizations or their committees, however, further research should be conducted to see if results obtained from participants would confirm the importance of this indicator.

Communication of results and information to volunteers should not be without recognition of their efforts in data collection (Heiman, 1997; Brock, 2001; DFO, 2006). There are several ways in which this can be achieved. Many organizations have dedicated an entire event to volunteer appreciation, while others ensure that a public thank you is circulated through local media sources or the organization's website. To maintain a strong volunteer base, groups should incorporate at least one event where broad or individual recognition of citizen commitment is a focus.

All groups involved in salmon stock monitoring and assessment cited participation in a variety of community events as a major communication tool. On Vancouver Island, there are many events that organizations can participate in, including sportsmen shows, river days, farmer's markets and water festivals in their respective municipalities. Groups can use these to their advantage, setting up displays, providing brochures and interacting with individuals to educate and engage them in monitoring and assessment. This in turn

has the potential to actively recruit volunteers for projects while broadly educating the community on current and proposed projects. Knowledge of community events and an individual in the organization whose sole responsibility is the coordination of these events would greatly increase the presence of an organization in the community and would strengthen the development of effective presentation materials for salmon stock assessment and monitoring in the region.

### **3.5 Community Programs**

Community programs developed and delivered by community-based environmental organizations aim to promote awareness of salmon enhancement programs in operation both province-wide and within their regions and can strengthen monitoring activities spearheaded by community-based organizations. The type of programming offered can constitute formal education programs, specifically those operating directly in classrooms, and community outreach and education. Community programming can directly influence the extent of community support and awareness of enhancement projects, and should thus be considered an important component of an organization's contribution to environmental management (Gray, 1995; Ivey *et al.*, 2002).

Community programs can also have an impact on the social capital of a region. Social capital contributes to the connections between individuals through building trust, sharing values and moving towards cooperative action and protection of environmental resources (Sparkes, 1995; Cox, 2006). These relationships are critical in establishing a long term bond between volunteers as well as increasing the reputation of a community-based group in the region, both of which are considered important indicators of organizational success. Social capital not only contributes to the management of natural

resources, it also increases the social network of those groups collecting environmental data in their respective regions, establishing a form of collectivity when dealing with an issue of potential environmental concern (Henig, 1982; Jones *et al.*, 2006). Additionally, social capital can strengthen relationships between groups and government agencies by broadening the understanding of stewardship initiatives and holistic environmental approaches to natural resource management.

### **3.5.1. Educational programs**

For the purposes of this study, educational programs will refer only to programs developed and presented in formal school systems across Vancouver Island. Although there is evidence of strong adult and family based educational programs, they will be discussed in greater detail in the following section.

Formal educational programs geared towards the Kindergarten to Grade 12 levels are supported by government programs in British Columbia, most notably, by DFO's Stream to Sea initiative (OHEB, 2006). DFO's current commitment to aquatic education has been greatly enhanced through the participation of community organizations that are willing to devote their time and manpower to promoting salmon stewardship programs in the schools. As a result, DFO continues to actively seek community partners whose educational activities are closely associated with the agency's mandate. This partnership has led to a solid program established and directed under the Stream to Sea strategy.

The main goal of all education programs that are delivered in classrooms on Vancouver Island is to build environmental stewardship among the next generation of B.C. citizens. Continuously evaluating the dominant social paradigm surrounding salmon conservation allows for organizations and leaders to identify areas of improvement, and to work towards a paradigm shift in environmental protection and an underlying

environmental ethic that maintains strong salmon conservation initiatives. Additionally, educational programs serve as an initial point for generating new enthusiasm and interest in salmon assessment and enhancement initiatives in a region. Through getting students actively involved in the process, organizations hope that students will continue a commitment to monitoring after the formal education process has ended (Morton, 2007; Peters, 2007; Rutherford, 2007).

All of the groups, both excellent and mediocre, were extensively involved in educational programs, particularly groups that went directly into classrooms to lead programs on salmon restoration and life cycles (Table 6). All of the groups stated that they maintained an aquarium in a classroom in their region, and regularly took school groups into an active monitoring site to participate in salmon assessments. This is positively associated with government support for formal education programs outlined above.

<i>Indicator Assessed</i>	<i>Number of positive responses (E)</i> <i>n = 6</i>	<i>Number of positive responses (M)</i> <i>n = 4</i>	<i>Interviewees</i>
Development and delivery of educational programs	6 (100%)	4 (100%)	E1, E2, E3, E4, E5, E6, M1, M2, M3, M4
Development and delivery of community outreach and education initiatives	4 (66%)	1 (25%)	E1, E2, E3, E6, M2

**Table 6** Indicators of development and delivery of community programs undertaken by community-based organizations on Vancouver Island, British Columbia  
Abbreviations: E = excellent; M = mediocre

### **3.5.2 Community programs: Public outreach and education**

Community programs are substantially broader in scope than educational programs being undertaken by community groups in the region, with the main goal being awareness

of specific projects or of salmon conservation. These programs, unlike formal educational programs discussed above, involve participation in outreach events, workshops and conferences. Furthermore, these initiatives can be a major starting point in the development of learning communities within a region, where groups contribute to the decision making process through collaborative processes and collective knowledge (Kearney *et al.*, 2007).

The use of community programs was not as widespread as educational programs in groups selected for this study. Four of the six excellent groups and one of the four mediocre groups used community programming and outreach on top of formal education projects (Table 6). The lower numbers for participation in community education among groups can be indicative of added demand on organizational resources, a factor that has not been overlooked in the literature (Nichols, 1992; Savan *et al.*, 2000; Ivey *et al.*, 2002; OHEB, 2006). Often, groups that are short of volunteers, funds or community support are unable to effectively participate in public outreach.

Many of the groups stated that their contributions to community education were satisfied through their presence at numerous community events. These events generally involved setting up an information booth or leading workshops or open house discussions on their activities. Always present at these events were volunteers and in-house publications to “talk up” local enhancement and assessment programs.

Group E3 indicated that there was merit in reaching out to the community’s adult population through educational programs and events. Specifically, Group E3 coordinated interpretative walks throughout their monitoring region, where species identification, promotion of restoration projects and development of a general knowledge of local environmental stressors were the main goals (Interviewee E3, 2007). These events were

popular in the region and fulfilled other indicators of organizational success through increasing communication efforts to the community and actively recruiting volunteers through fostering an ethic of stewardship.

### **3.5.3. Recommendations for improvements to community programming**

Community programs should be promoted among current and potential monitoring organizations located in the region of study as an additional communication strategy both for providing awareness of the issue of salmon stock assessment and to actively recruit volunteers to the monitoring campaign. Education programs in the area have provided sufficient evidence of their positive impact in the community, with DFO and the academic literature citing the long term benefits of stewardship initiatives, including greater community enthusiasm for local environment and salmon enhancement, shifting environmental paradigms, and both time- and cost-effective information gathering by government agencies and organizations (Scott & Herman, 1995; Sparkes, 1995; Ivey *et al.*, 2002; EMAN, 2003; Peters, 2007; Rutherford 2007).

The integration of media communications with public outreach events would increase cost- and time-efficiency of community organizations. Through coordinating media events with displays and interpretative activities, resources could be freed up and applied to other aspects of monitoring and enhancement. This would also minimize overlap that would occur in communication results and the group's mandate to the public and instead allow for greater focus on awareness campaigns.

Finally, maintaining a clear distinction between school education programs and community outreach and education programs is important in ensuring the inclusion of all members of the community. Through focusing solely on school groups, organizations could be losing access to a large untapped pool of volunteers in the form of adults with

the motivation and skills to contribute to monitoring activities. Demographic studies on Vancouver Island show that in large municipalities, there is a steady increase of retired citizens, whose diversity of skills and experiences could positively contribute to environmental initiatives being spear-headed by community-based environmental monitoring organizations (Morton, 2006).

### **3.6 Goals and Roles of Community-Based Environmental Monitoring Volunteers**

Communicating the project goals and volunteer roles to all participants involved in the monitoring process is also considered a component of effective communication strategies, however for the purposes of this study they will be considered as a separate indicator. These indicators are separated from Section 3.5 because communicating the goals and roles is done so in the development stages of projects and programs, whereas communication strategies occur throughout the entirety of the organization's existence. In this section, the goals and roles of community-based organizations monitoring and assessing salmon is based on the clarity of their presentation to the volunteer base.

#### **3.6.1 Goals**

Clearly stating the goals of a particular project or the overall goals of an organization has been clearly outlined in the literature as an important component of community-based environmental monitoring campaigns. Clear goals can be outlined in an action plan for a project, or can be continuously stated in all communications by the organization (Stadel & Nelson, 1995; MacDonald *et al.*, 2000; Ivey *et al.*, 2002). Through reiterating the goals of an initiative, organizations are also ensuring that all participants fully understand the reasons behind the monitoring activities and the ultimate use of the collected data.

Also, volunteer comprehension of projects holds the potential to foster greater environmental stewardship within the community as participants understand their role in the decision making process and the impact of community actions (Scott & Herman, 1995; Tonn *et al.*, 2000).

Only three of the excellent groups and one of the mediocre groups indicated that goals of the projects were stated in the development stage of monitoring activities (Table 7). As the literature clearly outlines the importance of well understood organizational and project goals, it is possible that the way in which the question was phrased in the interviews influenced the low positive response rate for this indicator. The groups that indicated broad goal communication pointed to their website as a means for an understanding of underlying goals of monitoring to be communicated, thus shifting the onus to the volunteer to acquire this information.

<i>Indicator Assessed</i>	<i>Number of positive responses (E)</i> <i>n = 6</i>	<i>Number of positive responses (M)</i> <i>n = 4</i>	<i>Interviewees</i>
Clear Goals	3 (50%)	1 (25%)	E1, E2, E6, M4
Clear Volunteer Roles	4 (66%)	2 (50%)	E1, E2, E4, E6, M2, M4

**Table 7** Indicators of successful communication of project goals and volunteer roles by community-based organizations on Vancouver Island, British Columbia  
Abbreviations: E = excellent ; M = mediocre

Clear project and organizational goals are an effective component of public participation in the decision making process. Issue familiarization, community visioning and collaborative decision making help volunteers understand their role in the organization and create shared long term and short term goals (Pinkerton, 1991; Whitelaw *et al.*, 1995; Tonn *et al.*, 2000; Pollock & Whitelaw, 2005). When dealing with salmon assessment activities, the actions associated with clear goal statement can refocus

programs on sustainability, with involved communities fostering stewardship and cooperative solutions for increasing spawning stock populations.

### **3.6.2 Clear volunteer roles**

The inclusion of defined roles for volunteers has been highlighted in the literature as an important organizational trait of community-based environmental monitoring organizations. Upon entering a project, volunteers are assigned a role for the duration of a project. This role is established to provide meaningful opportunities for volunteers as well as to eliminate overlap in responsibilities (Brenneis & M'Gonigle, 1992; Craig *et al.*, 1995; Ivey *et al.*, 2002; Pollock & Whitelaw, 2005). Roles can encompass project coordination, sample collection and media relations.

Four of the excellent groups stated that clear volunteer roles were delivered by their organization in the development stages of all projects, while only one of the mediocre groups indicated the same (Table 7). Contrary to the findings in the literature, dynamic roles were touted as the most effective in ensuring that volunteers maximized their skill sets and increased overall enjoyment in monitoring activities.

Roles of volunteers need to be clearly defined and understood for all projects and programs. Volunteers who are not aware of their responsibilities in the monitoring process can fragment activities through ineffective communication and unclear responsibilities (Clarkson & Andre, 2002). The literature highlights static roles as integral to promoting individuals' willingness to champion a specific aspect of the monitoring project. These static roles can be credited with ensuring the longevity of an organization as volunteers are presented with a feeling of greater permanence within a community-based organization.

### **3.6.3 Recommendations for improvements of volunteer goals and roles**

Goals of the project or program should be incorporated directly into all communication strategies. Not only should these goals be communicated on organizational websites, but they should also be actively outlined at the commencement of all monitoring and enhancement projects. This ensures that volunteers understand the importance of their monitoring activities, and are continuously participating in the learning process. This is of considerable significance for volunteers who are committed to several projects and/or programs within the organization, as principles of collaborative learning can be applied in ensuring sustainable management of natural resources.

Although the literature suggests that the structure of the organization should be clear and unchanging, interviews with community-based monitoring organizations on Vancouver Island suggest that roles should be more dynamic and evolve as volunteers find their niche in the monitoring activity. Although dynamic roles can result in substantial turnover within the organization, the benefits are striking in that volunteers then become more involved not out of necessity, but out of enjoyment. Indeed, volunteers who are actively enjoying their role are more likely to commit to the organization in the long term, thus ensuring sustainability of the salmon enhancement and assessment programs on Vancouver Island. Groups should also consider the option of identification of champion volunteers for roles in the development stages of a project. Instead of arbitrarily assigning tasks to volunteers, an open consultation process should be adopted to find out the specific interests of individuals. This can lead to more effective placement of individuals into organizational roles and can maximize the commitment of volunteers into the long-term.

When establishing project and organizational goals, community mapping, which is a process using maps to track communal knowledge of the spatial and temporal changes to local ecosystems, should be explored by all organizations involved in community-based environmental monitoring organizations on Vancouver Island (Pollock & Whitelaw, 2005). Community mapping is a process that aids in the collection of information that is specific to a community's values and interests while acting as a basis for setting long-term goals and focusing monitoring activities. All groups can benefit from this process, which is viewed as a transparent, inclusive and efficient means of collecting information on the needs of a community (Whitelaw *et al.*, 2003; Pollock & Whitelaw, 2005). The adoption of this tactic when outlining goals also can lead to the identification of stakeholders within the community, further widening the breadth of the impacts of monitoring. Due to the prominence of this strategy in the literature and citations of its application to other monitoring activities in British Columbia, further studies should be undertaken to determine the extent of community mapping initiatives in setting goals by groups in the study site.

### **3.7 Project Follow-Up**

Project follow-up should be undertaken as all sites monitored by volunteers to consistently assess the state of salmon habitat and salmon population numbers in the region. Increased urbanization in most communities on Vancouver Island requires that streams in the region must be continuously monitored to identify environmental stressors that have the potential to negatively impact salmon populations.

All of the excellent groups indicated that regular monitoring of all sites under their jurisdiction was completed on a regular basis, however none of them indicated that this

was indeed mandated within their organizational structure (Table 8). Several groups employed many innovative strategies in carrying out follow-up activities. For instance, groups E3 and E6 both indicated that through building relationships with adjacent land owners, they were able to conduct visual assessments of stream conditions on a daily basis (Interviewee E3, 2007; Interviewee E6, 2007).

<i>Indicator Assessed</i>	<i>Number of positive responses (E)</i> <i>n = 6</i>	<i>Number of positive responses(M)</i> <i>n = 4</i>	<i>Interviewees</i>
Project Follow-Up	6 (100%)	1 (25%)	E1, E2, E3, E4, E5, E6, M3

**Table 8** Indicators of successful project follow up initiatives undertaken by community-based organizations on Vancouver Island, British Columbia  
Abbreviations: E = excellent; M = mediocre

The mediocre groups, when questioned about their commitments to project follow-up, cited a lack of resources, including volunteers and funding that hindered their participation in any follow-up activity. Most answered that they hoped to undertake this type of activity in the future and echoed the importance of adaptive management processes that were articulated by the excellent groups.

Monitoring is considered to be an ongoing process for assessing the state of salmon populations of a specific stream, however, most organizations approach monitoring on a project by project basis. With the high volume of streams and projects available for organizations to monitor, sites must be carefully chosen to allow for maximum benefits to volunteers as well as salmon. This includes ensuring that sites are accessible by volunteers and that the stream has been identified as viable salmon habitat for both assessment and restoration purposes (Kearney *et al.*, 2007).

Continual and regular assessment of previous project sites is also an important component of adaptive management strategies for natural resources in British Columbia.

Adaptive management recognizes the complexities of interacting natural and social systems and uses an interactive process to gain a full understanding of the issue. Decision makers are then informed of the potential for changing circumstances and adapting to this change (Holling in Whitelaw, 2002). On an ecosystem level, adaptive management seeks to create processes that focus on ecosystem boundaries and embrace a holistic systems approach for the management of environmental issues. This process focuses on the variability of the ecosystem and the importance of local knowledge in informing all players on changes to the system (Whitelaw, 2002). When applied to salmon enhancement on Vancouver Island, adaptive management is a critical component to salmon as it responds to variability in population dynamics, restructuring conservation goals to reflect the natural system (MacDonald *et al.*, 2000).

Projects sponsored by DFO or by the Pacific Salmon Federation require documentation of regular monitoring of a site, even after the initial population or habitat assessment has been completed. As such, this does necessitate that follow-up occurs for some projects and is generally on an annual basis (Morton, 2006; Peters, 2007). Regardless of this requirement, it does not adequately cover all of the projects that have been, or are currently being undertaken by community-based environmental monitoring organizations on the island. As a result, data submitted from projects not funded by these organizations may not be valid when applied to current and future resource management strategies.

### **3.7.1 Recommendations for improvements of project follow-up strategies**

Community-based organizations should include project follow-up directly into their respective mandates to ensure that it occurs on a regular basis. Not only does following up on past projects point to any changes in local stream ecosystems, it also can actively

contribute to adaptive management strategies, where organizations recognize the dynamic nature of stream ecosystems.

Project follow-up should also be considered when pursuing stakeholder identification processes at the development stages of a project. Through actively including landowners nearby project sites, the time committed to organizing follow-up outings can be greatly minimized and a stronger relationship between the organization and the community can be maintained. Additionally, the inclusion of stakeholders undertaking daily or bi-weekly assessments of streams situated on or along private land means that a longer and more comprehensive picture of ecosystem conditions can be documented and applied to adaptive natural resource management in the region. This can also ensure that organizations gain legitimate access to private land, instead of only undertaking monitoring activities on public land, such as parklands and nature trails, or crown lands. Through gaining this access, they are once again providing a more comprehensive picture of habitat quality for salmon enhancement activities with monitoring (Nichols, 1992).

Reiterating the importance of adaptive management when discussing project follow-up can not be done enough. More monitoring and assessment occurring on a site allows for a decision making process that incorporates a systems approach to salmon enhancement activities. Thus, organizations involved in the monitoring and assessment of salmon populations should gain an understanding of the principles of adaptive management and include them in both their organizational mandates and their internal and external communication strategies, as outlined in section 3.4.

## **4.0 Conclusions**

The credibility of community-based environmental monitoring has been the subject of increasing academic study by scientists and those interested in monitoring natural resources in Canada. Regardless of the interest in the processes of community-based environmental monitoring, activities on stream ecosystems for the purposes of salmon enhancement on Vancouver Island have not been exclusively studied. Despite the criticisms of environmental governance and citizen monitoring, this research was able to assess several traits associated with successful community-based environmental monitoring activities being undertaken in this geographical jurisdiction, specifically pertaining to salmon stock assessment. The degree to which activities are making an impact is due, in part, to the many successful organizational characteristics of community-based environmental monitoring organizations. As a result, the identification of these attributes and recommendations for improvements can greatly contribute to more inclusive and positive management of salmon.

### **4.1 Attributes of Successful Community-Based Environmental Monitoring**

Community-based environmental monitoring organizations and OHEB CAs referred to the importance of (i) funding, (ii) training, (iii) standardization of methods and protocols, (iv) communication strategies, (v) volunteer goals and roles, (vi) community programs, and (vii) project follow-up. These attributes should all be considered as integral for successful and sustainable natural resource management by community-based environmental monitoring organizations on Vancouver Island, British Columbia.

The traits of organizational success can also be ranked in order of importance for monitoring and assessment processes specific to salmon conservation initiatives on

Vancouver Island. Funding and fundraising, communication strategies and standardization of methods represent the traits that organizations will benefit most from for their monitoring and assessment. Fundraising activities are integral to supplementing the operating budgets of organizations and would allow them to expand their monitoring campaigns to more locations and perhaps adopt stronger advocacy roles in the local community. Communication strategies represent an important link with the local community and should be nurtured throughout a project to ensure both broad-brush and financial support in the region. Finally, standardized methods should be incorporated into the mandates of all organizations undertaking salmon stock assessment on Vancouver Island as continuity between groups collecting data will both solidify the reputations of groups operating in the region and also facilitate networking and partnerships for the purposes of data sharing among organizations. Additionally, the standardization of data collection methods for all organizations reporting to OHEB would render the information more applicable within DFO. Data collected under the same protocols increases the usability of information by government bodies for the purposes of adaptive management principles and any necessary enforcement activities.

The main recommendation for DFO should then be to take a greater initiative in promoting standardized protocols for fundraising, communication strategies and methodologies of all groups associated with DFO OHEB. The need for this was demonstrated through the interpretation of questions administered to community-based organizations through the semi-structured interviews. Several groups interpreted the meaning of these indicators and their importance in contributing to organizational success of their monitoring and assessment. For example, several groups interpreted communication strategies simply as passing information to DFO while others interpreted

it as communicating the actions of the organization to the community in which they were operating. Thus, the clarification of indicators as well as their overall promotion can be accomplished through the development of modules for broad distribution or through the coordination of workshops pertaining to these specific indicators. Standardization of organizational structure of groups then has the potential to not only maximize the data being collected by organizations, but would also increase overall credibility of information being collected by community-based environmental monitoring groups on Vancouver Island as well as those in rest of British Columbia.

Regardless of the importance of these traits to successful natural resource management, they will not be as effective when applied individually. As such, the indicators outlined throughout this report when applied concurrently are associated with greater organizational success of groups involved in this study. Indeed, this study suggests that indicators are inherently linked, with groups undergoing difficulties in certain categories as a result of inaction in a corresponding category. For example, as outlined in section 3.7, Group M1 stated that their lack of follow-up activities on enhancement and assessment projects was due entirely to a lack of adequate funding (Interviewee M1, 2007); in contrast Group E2 recognized that stakeholder identification and community education on salmon stewardship initiatives was integral in solidifying their place in the natural resource decision making process. As a result, they implemented effective communication strategies through using local media sources to disseminate their monitoring results (Interviewee E2, 2007).

## **4.2 Recommendations for Future Research**

This section identifies two recommendations for further inquiry in addition to the recommendations outlined in each section. These recommendations are based on the results of this study and communications with community-based environmental monitoring organizations and affiliates undertaking salmon enhancement and assessment activities on Vancouver Island, British Columbia.

For each indicator this report provides several recommendations for improvements on organizational activities pertaining to salmon enhancement for each indicator. As such, it could act as a valuable resource for governments and communities engaging in monitoring and assessment across the study site, and for new groups beginning projects under the direction of OHEB. Through collaboration with DFO and OHEB, this report could be made available to all pertinent stakeholders engaged in salmon enhancement in British Columbia streams to ensure that the appropriate steps are taken to achieve successful long-term management of one of British Columbia's best known natural resources.

As this study highlights the activities being undertaken by a small sample of community-based environmental monitoring organizations in Vancouver Island, the results of this study could be solidified through increasing the sample size to include all organizations undergoing salmon assessment in the region. Expanding the sample size would lend greater validity to the use of these indicators to improve the management of salmon stocks. All have differing methods in the development and delivery of salmon enhancement initiatives and could bring new strategies and techniques to contribute to sustainable natural resource management. Additionally, the inclusion of groups engaged in monitoring and assessment activities that do not encompass salmon enhancement, but

instead focus their programs in another area of natural resource conservation, would be a logical step towards substantiating the findings of this research.

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## **5.2. Personal Communication**

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Phipps, B., Nunns Creek Stewards. Personal communication, 2007

Rutherford, T., Community advisor, Department of Fisheries and Oceans Canada. Personal communication, 2007

## **Appendix 1: Interview Questions for Community Advisors**

1. Can you briefly describe the type of activities you and/or your organizations are involved in?
2. How are individuals recruited for participation in projects? How do you ensure that they commit to the full lifespan of the project?
3. Have you noticed an increase in public awareness and/or participation in stream monitoring and restoration projects since the project(s) began? What do you think are the reasons behind this increase/decrease?
4. Do you use any programs in conjunction with the actual monitoring and restoration to captivate community interest and involvement in projects?
5. Are there any community outreach or education projects associated with past or existing monitoring and restoration projects?
6. Do you have an identifiable commitment to follow up on completed projects?
7. In the development stage of your projects, what steps does your organization take to ensure full representation of the local community?
8. Are participants given specific roles in the project? Are their roles and their place in the organizational structure clear to them and all other participants?
9. Have you encountered any major problems in monitoring and restoration projects? Can you provide any specific examples?
10. If problems did occur throughout the project, what changes would you make to lessen these problems?
11. Do you believe that your project is having a positive effect on environmental policy and awareness in Canada? Why?

## **Appendix 2: Interview Questions for Community Groups**

1. Can you briefly describe the type of monitoring being undertaken by your organization? On what land types is this monitoring being undertaken?
2. Are there clear roles outlined for volunteers when they first enter the project? Do these roles change or stay the same throughout the duration of the project?
3. How are volunteers trained? Is there any mandatory training before monitoring of a site begins? Who does the training?
4. Are there training refresher courses offered to existing volunteers to ensure their skill sets remain up to date?
5. In the development stage of your projects, what steps does your organization take to ensure full representation of the local community?
6. Do you use any programs in conjunction with the actual monitoring and restoration to captivate community interest and involvement in projects?
7. Are data collection methods/protocols standardized between projects? Between other network partners?
8. Are the goals and results of site monitoring communicated to the volunteers? To the community?
9. How is your organization funded? Is this funding permanent? How is it allocated to your organization?
10. Are the results of your monitoring published online or in paper copies?
11. What kind of information will you be gathering? Is this information shared with any other individuals or groups?
12. Does your organization participate in any community outreach or education programs?
13. Do you have an identifiable commitment to follow up on completed projects?
14. Have you encountered any major problems in monitoring and restoration projects? Can you provide any specific examples?
15. If problems did occur throughout the project, what changes would you make to lessen these problems?
16. Do you believe that your actions positively impact your community? Your region?

## Appendix 3: General Research and Ethics Board Approval



July 12, 2006

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Andria J. Sherstone  
Graduate Student  
School of Environmental Studies  
Queen's University

**GREB Ref # GENSC-005-06**

**Title: "Community Based Environmental Monitoring in Stream Ecosystems: Education Towards Sustainability"**

Dear Ms. Sherstone:

The General Research Ethics Board (GREB) has given expedited approval to your proposal entitled "**Community Based Environmental Monitoring in Stream Ecosystems: Education Towards Sustainability**". In accordance with the Tri-Council Guidelines (article D.1.6) and Senate Terms of Reference (article G), your project has been approved for one year. At the end of each year, GREB will ask if your project has been completed and if not, what changes have occurred or will occur in the next year.

You are reminded of your obligation to advise the GREB, with a copy to your unit REB; of any adverse event(s) that occur during this approval period (details available on our webpage [www.queensu.ca/vpe/greb/addforms.htm#Adverse](http://www.queensu.ca/vpe/greb/addforms.htm#Adverse)). An adverse event includes, but is not limited to, a complaint, a change or unexpected event that alters the level of risk for the researcher or participants or situation that requires a substantial change in approach to a participant(s). You are also advised that any adverse events must be reported to the GREB within 48 hours.

You are also reminded that all changes that might affect human participants must be approved by the GREB. Examples of required approvals are: changes in study procedures or implementations of new aspects into the study procedures that affect human subjects. These changes must be sent to Linda Frid at the Office of Research Services or [fridi@post.queensu.ca](mailto:fridi@post.queensu.ca) prior to implementation. Ms. Frid will seek the approval of the GREB reviewer(s) who originally assessed your application.

On behalf of the General Research Ethics Board, I wish you continued success in your research.

Yours truly,

A handwritten signature in black ink that reads "Joan M. Stevenson".

Joan M. Stevenson, Ph.D.  
Professor and Chair  
General Research Ethics Board

c.c.: Dr. Vicki Friesen, Biology, Faculty Supervisor

think Research  
think Queen's

Andria Sherstone

file copy

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9ajs3@qlink.queensu.ca, 04:39 PM 16/01/2007, Research Ethics Change Form GENSC-005-06

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To: 9ajs3@qlink.queensu.ca  
From: Linda Frid <FRIDL@post.queensu.ca>  
Subject: Research Ethics Change Form GENSC-005-06  
Cc:  
Bcc:  
Attached:

Dear Andria:

Thank you for keeping us up-to-date on your project "Community Based Monitoring in Stream Ecosystems". Your Change Form dated January 3, 2007 our ref. GENSC-005-06 has been reviewed by the GREB Chair, Professor Joan Stevenson. Please consider this email your approval to proceed with your changes as outlined. regards,

*Linda Frid, Coordinator*  
General Research Ethics Board (GREB)  
Office of Research Services  
Room 301 Fleming-Jemmett  
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