

Volunteer Lake Monitoring: A New Brunswick Model

by

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Introduction

Many of Canada's lakes are experiencing pressure due to increasing industrial activity, population increase, and climate change. Anthropogenic impacts such as effluent discharge, nutrient enrichment, acid rain, etc. combined with the effects of climate change have begun altering the condition of our lakes. Water run-off from industrial, urban, and agricultural activity, along with increasing water temperatures, leads to sedimentation, eutrophication, and harmful algal blooms within lakes. Unfortunately, New Brunswick is not exempt from these issues, and in certain lakes across the country changes are taking place much faster than anticipated. Future changes in temperature and rainfall amounts threaten to alter the physical, chemical, and biological attributes of our lakes (Vincent, 2009). The environmental and recreational values we associate with our lakes are being threatened, and swift actions need to be taken to mitigate and prevent negative impacts. This is especially true for New Brunswick, where recent years have seen a significant increase in toxic cyanobacteria blooms in several of the province's lakes.

In order to monitor environmental changes in our lakes over time, it is important that sound, scientific data be routinely collected. In Canada, federal departments, such as the Department of Fisheries and Oceans (DFO), Department of Natural Resources (DNR), Environment Canada (EC) and Parks Canada (PC), along with provincial departments of environment and natural resources implement environmental monitoring programs (Weston, 2011). Sadly, recent funding and budget cuts across the country have resulted in a decrease of necessary resources needed to effectively monitor our lakes. It is becoming increasingly difficult for our provincial governments to collect and analyze data for each of their lakes. In response, several provinces and many states within the U.S. have come up with a cost-effective way to help the government collect scientific data regarding the health of lakes. Over the past 30 years, citizen-based monitoring programs have become increasingly popular and have continued to evolve and improve. These programs provide technical training for volunteers, enabling ordinary people to collect data for a wide range of scientific parameters. These programs provide benefits by engaging and educating lakeside residents (including home, cottage, and landowners), and making them educated and aware of how they can help keep their lakes healthy. In return, provincial and state governments are provided with much more data and at a lower cost.

New Brunswick does not currently have a provincial volunteer lake monitoring program. However, there are a handful of dedicated people from across the province working to create a New Brunswick Alliance of Lake Associations (NBALA). This organization will create a unified voice for lake associations and provide education. The NBALA has also sparked a province-wide conversation regarding volunteer lake monitoring and is dedicated to the creation of this type of program.

This report will provide an overview of the NBALA and its creation, and describe what volunteer lake monitoring consists of and who can get involved. It will also provide a jurisdictional review of some volunteer programs that exist within both Canada and the United States, and provide recommendations on the type of program that can work for the province of New Brunswick.

What is Volunteer Lake Monitoring?

Volunteer monitoring, also referred to as citizen science, is the active participation of regular people collecting scientific data. This type of monitoring can be done within a variety of aquatic ecosystems, and give people the opportunity to become actively engaged in resource management (Kerr, 1994). Volunteer lake monitoring programs are designed specifically for lakes, and are designed to facilitate the collection of sound lake water quality data. A document titled "Volunteer's Guide to Water Quality

Monitoring” was published in 2000 by the New Brunswick Department of Environment and Local Government (DELG). It listed the benefits of such programs including:

- When groups of volunteers are responsible for collecting samples, it promotes a sense of stewardship.
- A volunteer monitoring program is cost-effective especially in a large watershed.
- Volunteers who participate come from varied backgrounds and have a wide variety of skills.
- Volunteers are usually from the area and are usually able to offer much in the way of local knowledge about sample sites and the surrounding area. (NB DELG, 2000)

Over the past 30 years, it has become increasingly apparent that volunteer monitoring has the potential to aide data collection for water resource management, especially in lakes. Since 1987, the U. S. Environmental Protection Agency (EPA) has been supporting the volunteer monitoring movement by providing guidance manuals, training, and funding to these programs (Simpson, 1991). With a growing need for more information, organized volunteer programs are helping to fill the gap where provincial and state agencies are unable to meet the demand. “Volunteer programs have been found to be of enormous value to states, which can gain a baseline of useful information on lakes that might otherwise have gone unmonitored”(Simpson, 2002). **Figure 1** illustrates the number of samples collected by the Maine Volunteer Lake Monitoring Program compared to state agencies in 2011.

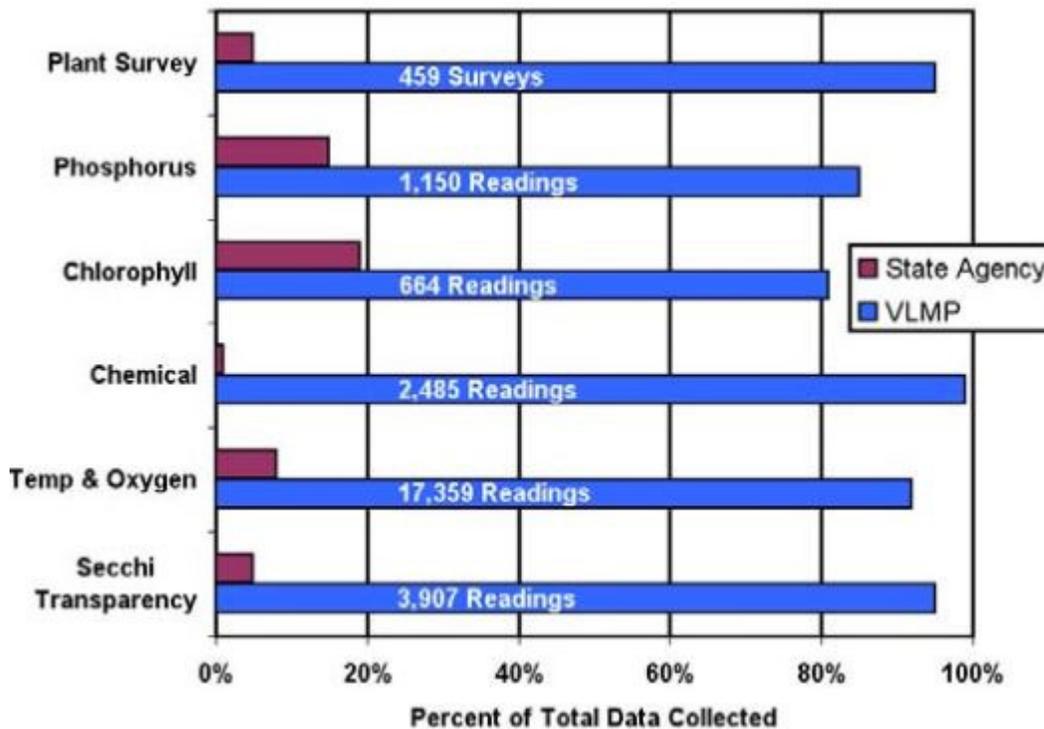


Figure 1: Percentage of lake data readings collected by Maine VLMP and state agencies in 2011 (Maine VLMP, n.d.).

Well planned monitoring programs that follow scientific methods and sampling protocols are cost-effective, and collected data can significantly contribute to the management of natural resources (Weston, 2011). The value from these programs comes not only from the large amount of credible data they can collect, but also by facilitating increased citizen participation and education. Any person willing and able to participate in volunteer monitoring can do so once they have completed necessary training

within their particular program. People are trained in sample collection, taught quality assurance/quality control (QA/QC) protocols, given access to proper equipment, and provided with a flexible monitoring schedule that can fit into their busy lives.

There are several water quality parameters that are typically measured by volunteer lake monitoring programs. These parameters are chosen based on their sampling cost, how difficult they are to collect, and how informative they are. Volunteer monitors are most commonly involved with collecting transparency data (Secchi depth), temperature, oxygen levels, and sometimes chlorophyll *a*, total phosphorous and/or nitrogen. These parameters are easy to collect and for the most part inexpensive to analyze, and help researchers understand how a lake may be changing over time. They can be used as early detection “alarm bells”, and they can indicate whether a lake may be experiencing eutrophication or an algae bloom (Simpson, 1991). Volunteer monitoring programs are also getting increasingly involved in training people how to identify invasive aquatic plants, and how to complete plant surveys to establish baseline data for naturally occurring species.

Methods

In order for New Brunswick to create a successful and robust volunteer lake monitoring program, it is important to examine these programs where they already exist. Information about existing programs was gathered from the internet, as well as from speaking directly to the representatives and employees of organizations that are running volunteer programs. The organizations investigated for this review include the Alberta Lakes Management Society (ALMS), the British Columbia Lake Stewardship Society (BCLSS), the Vermont Lay Monitoring Program (Vermont LMP), and the Maine Volunteer Lake Monitoring Program (Maine VLMP). Several other organizations were investigated including the New Hampshire Lakes Lay Monitoring Program (LLMP) and the Federation of Ontario Cottagers’ Associations; however the first four listed are those most applicable to the purposes of this report. Most programs are independent organizations that are run by an elected board of directors, while others are run out of government departments or within a university. Assessing different methods of operation that can be compared and contrasted is an important step in determining which options may or may not work in New Brunswick. Most organizations employ some combination of full-time or part-time staff responsible for organizing training programs and monitoring schedules. There is a variety of existing training programs and monitoring regimes implemented by monitoring programs, and different modes of quality assurance and quality control regimes. For example some programs have volunteers checking to make sure all of the data looks correct, while others have a government biologist checking incoming data. There is also a wide range of communication methods that organizations use in order to share data and keep volunteers involved and informed. Newsletters and annual lake reports are created so that participants can see how the data they collect is being put to use, and to remind people that their time is much appreciated. One of the most important aspects to investigate for this project was the level of government involvement and support provided for existing volunteer lake monitoring programs. This varies from program to program, however they all receive some level of support from their provincial/state governments, which makes the continuation of their work possible.

Most organizations have informative websites where a considerable amount of information for this project was collected. However, by setting up telephone interviews with staff or board members from each monitoring program, it was possible to collect key information about how programs are structured. There are many models used by the programs investigated in this report, and recommendations for a New Brunswick program have been made by taking these ideas and tailoring them to fit the needs of

this province. When speaking to representatives of other volunteer programs, questions pertaining to the topics discussed above were addressed.

Jurisdictional Review

Alberta Lake Management Society (ALMS)

The goals of the Alberta Lake Management Society (ALMS) are to provide education and awareness to the public about lakes, reservoirs, and watersheds. In addition to this, the society has also developed a comprehensive volunteer lake monitoring program that collects data used for the management of Alberta's Lakes. In 1991, the ALMS officially became an incorporated non-profit organization. Soon after this, the ALMS joined the North American Lake Management Society (NALMS), becoming the first Canadian Chapter within this organization. The ALMS is recognized as a charitable organization in Canada, and continues to work alongside the government, industry, watershed/lake associations, and the public (ALMS, 2007).

The ALMS board of directors is composed of a diverse array of people who all have a vested interest in the health and management of Alberta's lakes. Currently the board is made up of elected scientists, consultants, and members from lake groups and associations. Membership within the ALMS is not only made up of members of other lake associations, but also include municipalities, public and private sector individuals, students, and basically anyone else who is interested in freshwater resource management issues. Members receive monthly E-newsletters, and are able to participate in annual networking and education events that take place throughout the year. The ALMS employs a Program Manager, a Lakewatch Coordinator, and a bookkeeper who run the organization year round. During the summer months, two summer students or interns are hired to assist with the busy field season (ALMS, 2007).

Having three staff members has allowed the ALMS to run the volunteer lake monitoring program, and to provide education and outreach events and programs throughout the year. During the summer months, the ALMS runs the Alberta Water Quality Awareness (AWQA) Day, which gets people involved with water quality testing and teaches them about their lakes. Participants are given test kits that allow them to measure temperature, pH, dissolved oxygen and turbidity, and are asked to take their samples on June 5th. This day is not limited to lakes, and people are encouraged to test streams, ponds, wetlands, etc. if they want to. The data is submitted to the ALMS and put into a data base where the public can then view the map of Alberta's surface water quality that they have just helped create. The society has also begun working with First Nations communities doing education programs centered on lake health issues and water quality monitoring. They also plan to get involved with a province-wide volunteer Secchi disk program.

The ALMS volunteer lake monitoring program, Lakewatch, is primarily organized and executed by the Lakewatch Coordinator and the help of summer staff. Volunteer monitors, along with the summer technician and the Lakewatch Coordinator, monitor water quality parameters such as temperature, pH, and clarity. These parameters are chosen because they are relatively easy and cost effective to sample for. The ALMS receives funding each year that allows them to monitor 10 lakes throughout the summer. Lake associations and individual citizens are encouraged each year to submit their lakes to be considered for the monitoring program, and staff members decide which lakes will be monitored for the new field season. This decision is based on factors such as whether or not the lake has been monitored

by ALMS in the past (lack of baseline data), or the potential problems that a lake may be facing (i.e. pollution, algae blooms, etc.). Once the ten lakes have been chosen, monitoring sites are based on those that the government has monitored before. If a lake has never been sampled, a government biologist will assist staff in choosing ten sample sights within the lake, including the deepest part of the lake where a depth profile can be done. From the beginning of June until the end of September, each lake is monitored a total of five times (MacFarlane Dyer & Peter, 2012).

Unique to the ALMS' volunteer lake monitoring program, is that volunteers never actually perform the sampling procedures on their own. The role of volunteers within this program is to provide lake access to the technicians by taking them to their sampling sites in a boat. Technicians contact volunteers in May and set up the first sampling dates for each lake. The volunteers are expected to be on time and to have all of the proper safety equipment that is required onboard. In addition to this, the volunteers get to help collect the sample, find the sample sights, and record the data as it is collected. Since volunteers are not collecting samples or data on their own, there is no formal training program. New volunteers receive a Volunteer Welcome Package which explains the goals of the monitoring program, and outlines what is expected of them and what will be taking place on sampling days. Only a few trained individuals, usually with a post-secondary science degree, are collecting the samples, making it easier to assess their methods. Staff training is done by Alberta Environment, all equipment is cleaned and calibrated regularly, and there is a sampling QA/QC (quality assurance/quality control) protocol. All of the data that is entered in to the database is also checked by a government employee/technical expert. This sampling design allows for higher levels of QA/QC. The Lakewatch Coordinator also receives training in data management from the government (MacFarlane Dyer & Peter, 2012).

Once data is collected it is entered into a government database by the Lakewatch Coordinator, who receives data management training from qualified government employees. The entered data is checked by a government biologist who checks to make sure the numbers are logical, and then it becomes public information that everybody has access to. The Lakewatch Coordinator, with the help of the technicians, writes the lake reports. This job is also sometimes contracted out to graduate students conducting related research (MacFarlane Dyer & Peter, 2012).

The ALMS has estimated that it costs about \$7,000 per lake for them to monitor each summer. This cost includes not only equipment and lab costs, but also factors in wages and travel costs. The monitoring activities and outreach programs that ALMS performs are only possible with the support of Alberta's Provincial Government who until recently, has been providing up to 90% of the total required funds each year. Recent funding cutbacks mean that the society is unsure of where funding will come from next year, or if 10 lakes will still be able to go through the monitoring program. Fortunately, industry is also allowed to submit 10 additional lakes to Lakewatch, and the monitoring of these lakes is paid for by industry itself. There is also an option for municipalities or lake associations to pay for the monitoring to be done in the event they are not chosen as one of the ten to be monitored that year. This will help keep the society busy, however continued government support will be needed in order to keep effectively monitoring Alberta's lakes (MacFarlane Dyer & Peter, 2012).

BC Lakes Stewardship Society

The BC Lakes Stewardship Society was created to provide resources and support for exiting lake groups and associations within the province. In addition to giving lake groups a stronger voice, they also provide education materials and help create new lake associations. Over the years British Columbia has seen a decline in government funding for environmental programs. The Society saw the potential of utilizing

volunteers for long-term monitoring and data collection. In 2003, with the help of the Ministry of Water, Land and Air Protection (MWLAP) the society began its own volunteer lake monitoring program. A strong collection of baseline lake data has been created, and is being used to help manage both recreational and ecosystem values (BCLSS, 2012).

The society's board of directors is made up of a wide range of individuals from throughout the province. Roughly one third of the board is made up of Ministry of Environment Staff, a third are scientific professionals (scientists, consultants, etc.), and a third are members from lake groups and associations. The Society tries to keep these ratios to maintain diversity and an even balance. Board members are elected, and any member from a lake group is able to run if they are interested.

The monitoring schedule that has been implemented by the BC Lake Stewardship Society is unique in that lakes can apply for different levels of monitoring, depending on the needs of the watershed in which they are located. Under the BC Lake Stewardship and Monitoring Program, there are five different levels of monitoring that can be done. **Table 1** outlines each of the levels, and briefly describes the type of monitoring that occurs within each. The BCLSS has formed a partnership with the BC Ministry of Environment (MOE), and they consult one another and work together to determine which lakes require higher levels of monitoring (British Columbia, 2012). Every time a new lake group or association gets involved with the program, everyone comes to the table and collectively decides the level at which monitoring should begin. The higher levels of testing are paid for by MOE; they need to determine if it is within their budget and necessary for a particular lake to undergo a more complete study (Carter, 2012).

Volunteers submit all of their data to the BCLSS who store the data electronically in their offices, with files backed up regularly. **The data is also sent to MOE and incorporated into their provincial database so that everybody has access to the information that is being collected.** Groups that are participating in the first level of monitoring are asked to collect 12 evenly spaced samples between the ice-off, ice-on period (or from April to October if their lake does not freeze). **Once there has been data collected for three consecutive years on a lake, BCLSS staff will analyze the data and create a lake report that effectively illustrates the data that has been collected.** The BCLSS also writes reports for lakes involved in Level 2 & 3 monitoring programs, however higher levels of monitoring will be reported on by MOE officials or a consultant. In addition to providing lake reports, the society also sends out quarterly and monthly newsletters to all of its members and volunteers. This helps to keep people engaged and aware of what is happening in and around their lakes. It is important to note that the society owns several of its own dissolved oxygen and temperature multi-meters available for volunteers to use, and it is also sometimes possible for people to borrow equipment from MOE. In addition to this, some groups have been successful at obtaining funding (from TD Friends of the Environment Foundation) to purchase their own equipment to measure DO and T. There is even one group that has the capability to monitor conductivity and pH. The BCLSS accepts the data that is collected by groups using their own equipment and incorporates it into their database (Carter, 2012).

Compared to the Alberta Lakes Management Society, the BCLSS has a more rigorous training program for its volunteers, who are more actively involved in taking samples on their own throughout the summer months (BCLSS, 2012). **A number of training workshops are held each year, and are either taught by BCLSS staff or a government biologist.** At times, courses are also taught by members of the board who are qualified from either consulting work or scientific backgrounds. Upon completing training, volunteers become part of the "LakeKeepers" program which aims not only to participate in monitoring activities, but also raises awareness about lake issues and best management practices. The

workshops educate volunteers about topics such as how to create a lake stewardship group, lake ecology, invasive species, fundraising, etc (Carter, 2012).

Table 1: BCLSMP Levels of Monitoring (“BCLSS 2012)

Level	Description
1. Weekly Summer Clarity (Secchi) and Surface Water Temperature Readings	<ul style="list-style-type: none"> • A minimum of 12 readings are taken throughout the summer • Provides baseline information about a lake • This level can be easily coordinated by the BCLSS and its volunteers, and does not require any necessary involvement from the provincial government.
2. Spring Overturn Water Chemistry and Dissolved Oxygen (DO)/Temperature (T) Profile Complimented by Weekly Summer Clarity (Secchi) and Surface Water Temperature Readings	<ul style="list-style-type: none"> • Provides a higher level of baseline data • DO/T profile can be easily done by BCLSS staff and volunteer monitors • As an option, Ministry of Environment Staff can help BCLSS and volunteer with monitors in collecting spring overturn water chemistry samples
3. Same as Level 2, Adding Multiple Depth Water Chemistry and Biological Sampling Biweekly Throughout the Summer	<ul style="list-style-type: none"> • This helps provide information such as the possibility of oxygen depletion during the summer months, nutrient loading, and can help detect the level of plankton species that are present • Creates a comprehensive collection of baseline data • Taking a sediment core can be added to this level of management, in order to examine further how the lake has been changing over time • The majority of this work is still easily done by BCLSS staff and volunteer monitors, however some help can be required from the Ministry of Environment • In undertaking this level of management, there is a significantly higher cost and amount of effort that needs to be put in compared to levels 1 & 2
4. A Level 1, 2 or 3 Combined with a Watershed Study	<ul style="list-style-type: none"> • Provides information about the potential effects being caused by different land use practices (i.e., with this level, you could attempt to answer how much of an effect septic systems are having on a particular watershed/lake) • Help prioritize management efforts by putting more work into areas where it is most needed, or where the greatest positive outcome is possible • This level will most likely require the help of a consultant, as well as continued support and input from the Ministry of Environment. It can also continue to be greatly helped through the continuous work of volunteers and stewardship groups.
5. Full Watershed Assessment that includes 1, 2, 3 and 4 as well as Stream Monitoring for Water Chemistry and Assessment of Riparian Areas	<ul style="list-style-type: none"> • This is the ultimate watershed study, however it requires a lot of time and money • This level of monitoring is not practical or necessary for every watershed • A large amount of involvement from Ministry of Environment staff is required for this level



The Society must ensure that QA/QC protocols are followed by volunteer monitors, and there are several ways in which this is achieved. **Whenever possible, BCLSS staff or an employee from the Ministry of Environment will go out with volunteer monitors and audit their techniques.** The auditor will provide feedback and advice if needed. Another way that the Society helps keep volunteer monitors on track is by having all the information they need easily accessible on the BCLSS website. There are instruction documents that can be downloaded if volunteers need a refresher on protocol, as well as field datasheets that can be printed off. The Society also keeps track of who it has trained, and keeps in contact with them throughout the year to make sure they are still involved and have received proper training and auditing (Carter, 2012).

Since its creation, the Society has successfully obtained \$75,000 of funding per year from the Ministry of Environment. These provincial grants have been supplied in three year terms, which has allowed the society to plan long-term projects, and helped to reduce staff turnover rates. In addition to covering staff salaries, this helped pay for training programs and the cost associated with collecting data. Another provincial source of funding, the BC Gaming Commission, provides operations funding for things such as

office rent, utilities, insurance, etc. Unfortunately, due to recent budget cuts, 2012 is the first year that the ministry will be unable to supply the same amount of funding as in the past. The BCLSS monitoring program only received funding for one year from MOE, and it was granted six months later than expected. This removes a significant amount of money that the society has relied on over the years for its programs and staff. Typically there are two staff members, one full-time and one part-time, employed by the BCLSS. Since May of 2012, the society has been operating with only one part-time employee. In November 2012, the society received some provincial funding which will allow them to bring back another employee for May 2013; however the positions will now both be part-time (Carter, 2012).

Vermont Lay Monitoring Program

The Vermont Lay Monitoring Program is run within the Watershed Management Division of the Vermont Department of Environmental Conservation (DEC). The DEC is dedicated to restoring and conserving natural resources for both ecological values, and for human health (Vermont DEC, 2003a). Since 1979, the department has been using the skills of trained volunteer monitors to help them collect water quality data on Vermont's lakes, ponds, and other surface waters. Since this program is run by a government department, it does not have a board of directors overseeing operations. The monitoring program employs one full-time employee, and a seasonal program assistant who helps out during the busy summer months (Sargent, 2012).

The volunteers involved with this monitoring program actively collect transparency samples with Secchi disks. In addition to this, volunteers receive all of the bottles they will need for a field season to collect water quality samples within their lakes. The water quality samples measure for total phosphorus, chlorophyll-a concentration, and water clarity. Volunteers are asked to take a total of 9 water samples (Secchi readings plus bottles) throughout the months of June, July and August. Volunteers are asked to space out sampling events as evenly as possible, with no two sampling events taking place within five days. The monitoring program has the use of a state owned vehicle that is used to collect water samples from the volunteers. During the summer months the vehicle sometimes travels up to 1,000kms/week. Sample pick-ups usually occur bi-weekly and are sent to a state run lab for analysis (Sargent, 2012). In total, the Lay Monitoring Program monitors about 40 lakes within the state of Vermont, plus 25 sites within Lake Champlain. In 1990, Lake Champlain was designated as a resource of national significance. This led to the creation of the Lake Champlain Basin Program (LCBP) which aims to reduce pollution and support restoration and management projects (Vermont DEC, 2003b). The 25 stations that are monitored here by the Vermont Lay Monitoring Program are funded by the LCBP and the U.S. Environmental Protection Agency (EPA) (Sargent, 2012).

Volunteers are not limited to just participating in basic water quality sampling, as the lay program has several other projects available for interested volunteers. Vermont Invasive Patrollers (VIPs) are trained to look for and identify invasive species within their lake. Participants must complete two invasive species surveys per year on their lake, and are able to submit any specimens that they are unsure of or unable to identify. There is also a Citizen Lake and Watershed Survey Program, which teaches individuals and lake associations how to assess their lakes and surrounding areas for potential pollution sources. By locating where pollution is coming from, concerned community members can begin to correct problems. The volunteer monitoring program, along with the invasive species and watershed survey programs provide a mixture of classroom and field training opportunities. New training options are currently being investigated with hopes of continuing to build the VLMP (Sargent, 2012).

Every summer, a staff member from the program accompanies volunteers while they are taking samples to ensure that they are still following all of the correct protocols, and to provide advice where needed. Some volunteers have been collecting data for up to 35 years, so as long as their methods are approved by an auditor, people are not required to keep going through training programs once they have been completed. However, for the VIP program, volunteers must redo training every three years as a refresher, and also to keep them updated to potentially new invasive species. Data that is collected by volunteers is submitted to the program staff. They enter, analyze, and manage the information using Sigma Plot software. The data is also incorporated into a government database where it can be accessed by anyone. The Program Coordinator uses the data to create yearly "report cards" for each lake. The new Program Director is looking at ways to update these documents, as the same format has been used for many years and it is time for an update (Sargent, 2012).

Since this program is run by a government department, the government provides the main source of funding. The Vermont DEC realizes that volunteers can collect sound data by following certain protocols, providing the government with significant amount of baseline data for many more lakes than it would be able to collect on its own. In addition to this, it gets landowners actively involved with the management of their lakes and promotes best management practices (Sargent, 2012).

Maine Volunteer Lake Monitoring Program

The Maine Volunteer Lake Monitoring Program (VLMP) is a non-profit organization dedicated to preserving lakes by fostering citizen participation and stewardship, and by collecting sound scientific data using highly trained volunteer monitors. It is one of the oldest, and largest, volunteer monitoring program in the United States. It was formed in 1971, has over 1,000 active volunteers, and monitored almost 400 lakes throughout the state in 2011. Today's knowledge of Maine's lakes can be largely attributed to the many volunteers who have dedicated their time over the years (Williams, 2012).

Although any interested citizen within the state is eligible, the Maine VLMP Board of Directors is typically comprised of individuals who are connected to Maine's lakes in some way. These include retired agency personnel, natural resource legislators, volunteer monitors, etc (Hill, 2012). New board members are elected in, and there is a maximum of 15 members at a time. In order to make the board more dynamic, there has been a recent push to recruit new members possessing marketing and fundraising skills (Hill, 2012). The VLMP employs several full-time staff members including an executive director, program coordinator, and at times provides internship opportunities for university students.

Hundreds of volunteers are trained to use Secchi disks to record water clarity and lake transparency. Volunteers who wish to become more involved have the option to participate in collecting slightly more advanced indicators such as temperature, dissolved oxygen, total phosphorous, chlorophyll a, etc. (Williams, 2012). Secchi disk readings and recordings are taken twice a month from spring to fall. Oxygen and temperature readings can be done on the same schedule as the Secchi disk readings. Measuring for total phosphorous is not as frequent due to the associated lab costs. The VLMP suggests that volunteers trained to collect phosphorous samples try and do this twice during the summer monitoring period (May-Oct) (Maine VLMP, n.d.). When financial resources are available, the VLMP attempts "baseline" data collection on lakes of special concern. These studies take place every few years and require volunteers to complete extra training as more water samples are being collected. These include: total phosphorous, chlorophyll-a, color, conductivity, pH, total alkalinity, phytoplankton, cations and anions, and zooplankton (Maine VLMP, n.d.).

The Maine VLMP has rigorous training and certification programs that volunteers must complete before collecting water quality data. There are many different levels of training available, ranging from Secchi disk training to advance lake monitoring (Williams, 2012). Thorough training ensures that credible data is being collected and entered into the VLMP and Department of Environmental Protection's (DEP) database. All training programs are based on a Quality Assurance Project Plan (QAPP) that has been approved by the U.S. Environmental Protection Agency (EPA). The Maine DEP provides support, quality assurance tools, and other resources to ensure that QA/QC standards are met by VLMP volunteers (Williams, 2012). Once training is complete, individuals become "certified" within the VLMP and are given a unique certification number which allows the program to keep track of where submitted data comes from. It also makes follow-up and evaluating sampling procedures more convenient. There are numerous training workshops held throughout the year, and volunteers must complete re-certification training every few years (Williams, 2012). VLMP staff help organize training sessions and workshops with the help of volunteer Regional Coordinators.

In addition to having volunteer monitors that are in the field collecting samples, the VLMP also has volunteer Data Coordinators who are responsible for collecting data forms and entering information into the database. Volunteers working with data also receive training to ensure QA/QC protocols are followed, and that the data remains credible. This is imperative as many entities use the data gathered by the VLMP. These users include the Maine DEP (and other state agencies), U.S. EPA, University of Maine (as well as some other educational institutions), County Soil & Water Conservation Districts, Towns, Planners, Businesses, Lake Associations and Grassroots Organizations (Williams, 2012). The use of VLMP data by scientists, agencies, and lake associations in multiple projects and studies continue to improve the understanding and protection of Maine's lakes.

In 2003 the VLMP, with the help of aquatic ecologist and environmental educator Roberta Hill, created the Center for Invasive Aquatic Plants. In response to increased threats from invasive species, the program is composed of three initiatives: prevention, early detection, and rapid response. Invasive Plant Patrollers (IPPs) are volunteers trained to identify invasive plants, conduct surveys, proper collection of unknown species, as well as preventative measures (Williams, 2012). Volunteers must complete an application process, attend at least one invasive species training workshop, and sign a statement of commitment to the program. Once training has been completed, volunteers must attend a training workshop or submit aquatic plant screening survey reports once every three years in order to remain in the program (Williams, 2012). The goal of this program is to teach volunteers how to identify invasive species, differentiate them from similar looking native species, and properly collect an unidentifiable species. It promotes early detection and rapid response techniques throughout the state. Many volunteers have gone through the training; there are approximately 400 active Certified Invasive Plant Patrollers currently in Maine. They already have success stories of volunteers identifying non-native plants and working with the VLMP to remove them from lakes before a complete infestation occurs. The IPP program continues to distribute technical and educational information to volunteers and the public regarding the threat of invasive species in Maine waters (Maine VLMP, n.d.).

When the Maine VLMP was first created, it was run by the Maine DEP, and therefore fully funded by the state government. The program became an independent, non-profit organization in 1996, and since then the government has continued to provide a large portion of the funding through grants and contracts (Hill, 2012). The VLMP is always actively seeking other avenues of funding, such as contributions and donations, but the close relationship with the DEP and the government's continued support plays a key role in the success of the program. The Maine DEP recognizes the applicability of volunteer based monitoring for the management and conservation of Maine's lakes.

Discussion

Each of the volunteer lake monitoring programs that were reviewed for this report have unique characteristics that have evolved over time. It will be important to use concepts and methods that have already been proven successful by other organizations, and at the same time create a unique and realistic volunteer program that is specific to the needs of New Brunswick. There are aspects of each program that may work if implemented and others that may not be suitable for this province. Appendix A summarizes the four monitoring programs discussed within the jurisdictional review. In this section current lake monitoring infrastructure within New Brunswick will be discussed. Program management options, water quality parameters, monitoring schedules, training and staff, data management, and current and future challenges will also be addressed.

Program Management

Within this jurisdictional review, there were two main types of program management in place among the different organizations. The programs and associations were either run by a state agency or, more commonly, an independent organization managed by an elected board of directors. In some cases, volunteer programs are housed within a university, such as the New Hampshire Volunteer Lay Lake Monitoring Program, which was not reviewed thoroughly for this report. In the case of Vermont's volunteer program, it was envisioned and created by the Vermont Department of Environmental Conservation (DEC), and remains housed in the DEC's Watershed Management Division. The obvious advantages of having a government operated program, is that it is fully supported by the state. Conversely, independent organizations are typically always looking and eligible for new funding opportunities and while they rely heavily on government support, they are also able to develop diverse funding portfolios that make them less financially dependent on government.

Independent organizations have a number of options for how their governing board will be comprised. Some allow anybody who is connected to lakes or lake management to run, while others want to limit it to those with professional backgrounds. For example, ALMS and the Maine VLMP have elected boards made up of scientists, consultants, and even members from lake associations that participate in their programs. The BCLSS also places value on having a diversified board of directors; however it is more limited to professionals as they attempt to maintain an even balance on who is serving. As mentioned in the results section, they strive to maintain an even ratio between Ministry of Environment Staff, scientific professionals, and members from lake associations.

Water Quality Parameters and Monitoring Schedules

When choosing water quality parameters for a volunteer monitoring program, it is imperative that they are easy and cost-effective to collect. For the most part, all of the programs reviewed for this report were involved with recording clarity (Secchi disk), oxygen, and pH data. Within each organization volunteers are asked to collect samples from spring to fall and, rather than having a rigid schedule, ask that a minimum number of monitoring events take place. For example the Maine VLMP asks that two sampling events (for the above parameters) take place each month during the sampling season. Volunteers that do additional testing, such as for phosphorus and nitrogen, collect that data twice per field season. Water samples are also quick and easy to collect, however there is an associated cost for laboratory analysis. Organizations deal with this cost in a number of ways as water samples provide more detailed information on what is happening in a lake. The Vermont LMP collects a substantial amount of water quality samples, and since it is state run is able to process samples at government

facilities for a discounted rate. The ALMS receives funding to do a specified number of lakes each year. This allows them to do a full analysis of each lake, rather than having water samples routinely collected and submitted by volunteers. The model implemented by the BCLSS, and perhaps the most applicable model for New Brunswick, uses a tier or level system, which helps manage time and resources. As shown in the section describing the BCLSS, lakes within the program are categorized into one of five different categories, based on factors pertaining to their environmental state. A tiered approach would be most applicable to the New Brunswick situation. It would allow government, lake associations, and academic partners to collaboratively choose the extent of monitoring to be done within each lake based on threats and available funding.

Staff and Training

Over time, volunteer monitoring programs become complex as more people continue to get involved. More data is submitted which needs to be analyzed and reported on, more training programs need to be held for a growing number of volunteers, and equipment use needs to be organized and distributed fairly. Volunteer monitoring programs benefit greatly from having one or more staff members to organize the program and manage volunteers. Some programs employ one staff member all year, and hire additional personnel during the summer months when active monitoring and training programs are taking place. Other programs that are larger and have been successful at obtaining large amounts of funding such as the Maine VLMP and ALMS, who have multiple year-round employees. The ALMS has an executive director who, along with a bookkeeper, is in charge of administrative tasks, securing funding, writing reports, etc. They also employ a Lakewatch Coordinator who is responsible for organizing the volunteer program, collecting samples, supervising summer students, data management and report writing. Individuals hired for these lake programs have relevant education or experience related to lake management, such as biology or environmental science degrees.

Having staff members to keep equipment organized and calibrated, keep volunteers involved, and to organize data and write reports are all important components to having a successful volunteer monitoring program. Staff members also play a crucial role in organizing and conducting training programs, as well as doing follow-up quality assurance/quality control (QA/QC) auditing with volunteer monitors. Proper training programs and QA/QC procedures are the key component to ensuring that data being collected is of high scientific quality (Simpson, 1991). Volunteers within the Maine VLMP are required to redo training every couple of years, depending on what type of samples they are collecting. For example an individual who is involved in the IPP program is required to complete re-certification courses more often than a volunteer who collects only Secchi disk readings. Other programs make a point of scheduling time with volunteers to assess their monitoring techniques, and provide advice or assistance where needed. The Vermont VLMP staff audit volunteers as often as possible. This method works for Vermont as it is a much smaller state with fewer lakes compared to Maine.

Data Management

Having a comprehensive training program and QA/QC procedures in place are necessary for in order for volunteer data to be recognized as credible. Quality Assurance Project Plans (QAPP) are an effective way of ensuring quality control for data collection, management, and analysis. The Maine VLMP developed it's QAPP to meet US EPA standards so that their data can be used by the state Government. Volunteer monitoring programs should also provide their volunteers with easy to use field data sheets, and make sure that information regarding the QAPP and data collection methods be readily available to all volunteers. These documents can be distributed in hard copy, but are typically also available on most of

the program websites. It is also important to educate volunteers about what different water quality parameters indicate, and explain why each sample is necessary to collect.

When large amounts of data are being collected, it is imperative that there be a secure place where information can be stored. While some volunteer programs have their own databases or spreadsheets where they keep track of their data, all of the programs researched in this report also incorporate their data into their provincial or state government database. Governments recognize the benefit of data collected by volunteer monitors, and this also allows data to be easily entered and extracted.

New Brunswick Lake Monitoring – Current Infrastructure & Activities

There is currently a considerable amount of lake monitoring being done in New Brunswick by the Provincial Government, non-profit organizations, and volunteer monitors. The St. Croix International Waterway Commission takes samples from lakes within the St. Croix Watershed every five years. They collect oxygen and temperature data, as well as water samples that are processed with funding received from the Environmental Trust Fund (ETF). In recent years, Eastern Charlotte Waterways Inc. has been involved in lake monitoring; specifically the lakes within the Chamcook watershed, as well as Lake Utopia and Digdeguash Lake. Parameters measured include oxygen levels, pH, total nitrogen and phosphorus, depth profiles, clarity (Secchi disk), chlorophyll a, and major ions and cations. There are also depth loggers in several of the lakes, as well as a data logger hydro lab that is rotated between the lakes on a bi-weekly basis. This work is also funded through the ETF, and previously received support from the Atlantic Ecosystem Initiative.

The Canadian Rivers Institute (CRI) is also involved in monitoring New Brunswick's lakes. In addition to collecting water quality/chemistry data, they collect information pertaining to fish and benthic lake communities. The CRI also manages a database called the Aquatic Data Warehouse, where the provincial government and other organizations can store their data. They are currently modifying this database to be more user friendly, especially for groups or individuals who wish to upload lake data. The new database will be called "NB Waters", and may be a possible database for future volunteer lake monitors to upload their data. Another possibility for data storage comes from the CURA H2O (Community-University Research Alliance Water) Program, which has been developed by the Community-Based Environmental Monitoring Network (CBEMN) at Saint Mary's University in Nova Scotia. Dr. Cathy Conrad is the founder of both organizations, which aim to facilitate volunteer monitoring and citizen science by providing necessary resources. The CBEMN houses an equipment bank which allows non-profit and community groups to rent scientific equipment free of charge. CURA H2O has developed a project called "WetPro" which is composed of an online volunteer training module and an equipment tool-kit. The training module teaches people about basic water quality parameters and the methodology for conducting water quality testing and sampling. Equipment tool-kits can be used by volunteers who have completed the online module, and are also given to organizations or lent out for free. The WetPro toolkit consists of everything needed to conduct basic water sampling including: sample bottles, first aid kit, measuring tape, cold pack, rubber gloves, field notebook, foldable bucket, Secchi disk, Garmin Oregon 550 GPS, YSI Professional Plus multi-probe, digital thermometer, coliform/phosphorus/nitrate test kit, and a battery charger. A newly developed database is also now available for trained volunteers to upload their data. It is straight forward and easy to use, and even has a phone application that can be used to upload data directly from the field.

Volunteer monitoring has also begun on a relatively small scale by members of lake associations in the Fredericton area, and by Lac Unique and Skiff Lake Associations which are respectively located in the

north-western and south-western regions of New Brunswick. Several years ago, a number of lake associations from the Fredericton area started working together in an attempt to get funding from the Environmental Trust Fund (ETF). The goal was to purchase equipment that could be used for volunteers to start monitoring water quality within their lakes. These groups included Lake George Habitat Preservation Inc., Yoho Lake Association, Davidson Lake Association, Harvey Lake Association, and the Magaguadavic Lake Association. Lake George now owns some of its own equipment, and the other lakes share some equipment that was all purchased with ETF grant money. For three summers, Lake George has been monitoring temperature at the surface, in depth profiles, gathering Secchi disk readings, as well as O₂, pH, and conductivity levels. This past summer, the other lakes started a monitoring program with shared equipment. These same lakes have also started working towards the creation of a New Brunswick Alliance of Lake Associations (NBALA), which will bring together lake groups from across New Brunswick.

The concept of having a regional coalition of lake associations is not a new one. The Maine Congress of Lake Associations (COLA) was established in 1970 with the purposes of connecting both individuals and lake associations. The purposes and goals set out by the Maine COLA, as can be seen in Appendix B, have allowed the organization to assist with the creation of new lake associations, provide various levels of support for existing associations, improve lake safety, as well as provide input regarding both new and old state legislations where they pertain to lake management (Maine COLA, 2012). They also have a relationship with the Maine Volunteer Lake Monitoring Program, where information is shared and support is given where necessary. The North American Lake Management Society (NALMS) has similar goals to the Maine COLA, but on an international scale. The goals and objectives of NALMS can be seen in Appendix C. These types of organizations bring like-minded individuals and groups together and provide a two-way channel of information; they also provide the necessary resources to reach common goals.

The idea for New Brunswick Alliance of Lake Associations (NBALA) was born at the 2011 New Brunswick Lakes Workshop, which was hosted by Eastern Charlotte Waterways Inc. This conference brought together lake associations, as well as interested individuals from across the province to network and share information about the current issues facing the province's lakes. Here, the need was identified for a provincial lake association which would unite individual lake associations. (Appendix D illustrates the existing lake associations that are currently in New Brunswick). Representatives from the five aforementioned lake groups sought guidance from Eastern Charlotte Waterways Inc., to help them begin to establish the NBALA. The NBALA is currently composed of a steering committee, but have plans to be incorporated by next summer. In addition to providing resources, education, and a unified voice for NB's lake associations, they will provide guidance for the creation of new lake associations and house the provincial volunteer lake monitoring program (refer to Appendix E). Most provinces have some form of provincial lake organization, and many are actively involved in organizing and implementing volunteer lake monitoring programs. It is time for New Brunswick to create what so many other provinces already have, however it is also important to design a program to fit the needs of our province, with the capacity to collect the most useful information for our provincial government and our citizens. The vision of the NBALA is to work alongside the Provincial Government, The Canadian Rivers Institute, and its member lake associations to make this concept a reality. New Brunswick citizens and their lakes will benefit from the establishment of the NBALA as it will have the capacity to assist and support smaller lake groups, and have the resources to organize and implement a province-wide volunteer lake monitoring program.

Challenges

As New Brunswick moves forward with the implementation of a volunteer lake monitoring program, there are several key challenges it will face. Keeping volunteers engaged, establishing a database, and securing long-term funding and support are three key challenges that the program must find ways to overcome. People become volunteers within their community for various reasons. They get involved because they wish to have an impact, be an advocate, to be part of an organization, to learn, for personal pride and fulfillment, and sometimes just for fun. (The Volunteer Monitor, 1996) According to all of the volunteer monitoring programs contacted for this report, one issue that they all face is volunteer “burn-out”. Some NB lake associations that have begun volunteer monitoring activities have indicated that they are already dealing with this issue. Volunteers want to see how their data is contributing to lake management and what their results mean, however there is not yet an effective way for NB lake associations to analyze or report on what they have collected. Established volunteer lake monitoring programs deal with this problem in a variety of ways; sending out newsletters, organizing conferences, creating lake reports, and keeping communication lines open help keep volunteers active.

As a volunteer lake monitoring program for NB continues to move forward, the use of a functional database becomes crucial to the program’s success. While other volunteer programs have access to provincial water quality databases, it does not appear that this will be an option in NB. While the CRI is creating a database that will have the capacity to store a variety of lake related data, it will not be complete until the spring of 2014, and there will most likely be a cost associated with using it. The CURA H2O has also established a comprehensive database that has been designed specifically for the use of volunteer data. If this database is used, volunteers would have to complete the WetPro training module, and most likely have to complete additional training from NB DENV personnel to ensure data credibility within the province. Another problem lies in the fact that some lake groups already collect data with their own monitoring equipment. For QA/QC purposes, this data most likely will not be accepted into the database. There are costs and benefits associated with each database that will need to be carefully examined when determine where volunteer lake monitoring data will be stored. It is essential that one database be established for volunteer use in New Brunswick, and all data should be entered into this one location.

One of the most pressing issues that a New Brunswick volunteer lake monitoring program faces is where long-term funding and support will come from. Volunteer monitoring programs, regardless of the ecosystem they are focused on monitoring, require governmental support in order to be successful. Financial support is important, and equally important is that the provincial government support the effort that is being made by the volunteers. All of the programs discussed within this report are recognized by their Provincial and State Government as useful resources. In Alberta and BC, the provincial government has historically provided the majority of the funding that their volunteer programs need to operate. While financial support is extremely important, government also need to support the efforts of volunteer monitors and acknowledge their value. As discussed before, the US EPA has worked closely with the Maine VLMP to create a QAPP so that the state can use volunteer data. In many of the programs government officials serve as board members, they help teach training workshops, and provided services (such as lab work) at discounted rates. These are just a few examples of ways that a local government can do for a volunteer program. Volunteer monitoring programs aim to gather data that will aid provincial and state government with resource management, not to hinder them. A commitment must be made to provide long-term support for monitoring programs to be successful (Lovett, 2007). The program needs to be recognized, not only as a cost-saving by having

volunteers collecting data, but as a key component for the management and preservation of our lake resources (Weston, 2011).

Recommendations

When it comes to NBALA, the current proposal is that it will be governed by a board of directors made up of individuals from member lake associations. This model will still allow the board to maintain diversity as people with an array of backgrounds will presumably be elected. Examples include retired and working government employees, scientists, consultants, fundraisers, people with accounting skills, etc. Having the board composed of members from existing lake associations will bring together like minded people with the same goals, and a broad range of experience, talent, and skills. A maximum number of elected board members should be established, and it will be important to make sure that different regions of the province, as well as both official languages, are equally represented within the board.

Once NBALA becomes an established organization, a practical and effective volunteer monitoring program can be developed. It is recommended that a tier system, such as the one implemented by the BCLSS, may be the best option for NB. A tier system allows for some flexibility in the level of monitoring lake associations wish to commit to, and will help make the best use of available resources. Table 2 demonstrates a unique tier system that could be implemented in New Brunswick for a volunteer lake monitoring program. Having different levels of management will help ensure that existing resources are put to use where they are needed most, and where their efforts will be most effective.

The monitoring activities of tiers 1 & 2 will help collect basic baseline data on lakes that are experiencing little adverse environmental impacts. Collecting clarity data helps paint a picture of how lakes are changing over time, and helps to serve a warning bell for potential problems. Depending on funding, time, and available equipment lake associations and volunteer monitors can choose between doing just Secchi readings and more advanced monitoring. It is suggested that whenever possible, bi-weekly sampling be done from spring to fall. This sampling regime is based on the schedule implemented by existing volunteer lake monitoring programs. Lake associations should receive Secchi disks upon joining the program free of charge, with the understanding that it will be returned if they wish to leave the program. More expensive equipment, such as a YSI multimeter, can be shared among the groups who already own them, or purchased by applying for ETF grants and other funding sources. Another option for groups when extra equipment is needed is to borrow WetPro kits from Eastern Charlotte Waterways Inc. (ECW) that have been supplied by the CURA H2O. The higher tiers of lake monitoring will be implemented when there is reason for more intensive monitoring within a lake or watershed, such as cyanobacteria blooms or evidence of pollution. Within tier 3, it is stated that volunteers must prove their ability to follow quality assurance/quality control protocols. It is important to note that this is true for all volunteer monitors, regardless of the level of monitoring they are participating in. Tier 3 will help lake associations determine what is impacting their lake and whether or not conditions are improving over time. This level will help determine the need for Level 4 monitoring, which is much more time consuming and costly, but will be necessary in some cases. It is also recommended that sample points be located in the same place as provincial sample points. Not only does it allow for the comparison of data over time, but volunteer data can then be compared against current provincial data. There will also be a considerably larger dataset that includes information from lakes that are not typically monitoring, or have perhaps never been monitored.

Figure 2 Proposed Tiers for Volunteer Lake Monitoring in New Brunswick

Tier	Activities	Equipment & Training	Notes
1	<ul style="list-style-type: none"> • Bi-weekly Secchi disc and surface water readings 	<ul style="list-style-type: none"> • Secchi disc, digital thermometer • One hour of training 	An introductory level of environmental monitoring. Sampling points should be based on those already set by the NB DENV.
2	<ul style="list-style-type: none"> • Level 1 activities • Bi-weekly pH, DO & conductivity readings • 2x in-field tests for nitrogen, phosphorous, & bacteria 	<ul style="list-style-type: none"> • YSI Multimeter, Lamotte testing kits • Two hours of training including calibration and methodology 	YSI Multimeters can be shared amongst groups. Sampling points should be based on those already set by the NB DENV.
3	<ul style="list-style-type: none"> • Level 2 activities • 2x *B & chlorophyll a analysis 	<ul style="list-style-type: none"> • Sample bottles & lab analysis • Three hours of training including sampling methodology 	Groups must prove themselves capable of adhering to the necessary QA/QC protocols to provide worthwhile data to DENV. Sampling points should be based on those already set by the NB DENV.
4	<ul style="list-style-type: none"> • Level 3 activities • Watershed study 	<ul style="list-style-type: none"> • Contracted consultant 	May include, as necessary, physical and historical characterization, targeted sampling (sediments, phytoplankton, etc.), stream monitoring, riparian area assessment, etc.

Another long-term goal for a New Brunswick Volunteer Lake Monitoring Program is to incorporate screening for invasive aquatic species. As Figure 2 illustrates, volunteer programs have a large capacity to screen invasive species compared to that of a private or provincial agency. The threat of invasive species is growing with the effects of climate change and the constant movement of humans (Dukes, 1999). Roberta Hill, the Maine VLMP’s aquatic ecologist and environmental educator, helped establish the VLMP’s Center for Invasive Aquatic Plants. Since invasive species have been identified in a number of Maine lakes (Maine VLMP, n.d.), we can assume that they also pose a threat to New Brunswick waters. The Maine VLMP has been building a relationship over the past few years to help the Quebec Volunteer Lake Monitoring Program, providing resources and sharing experience and knowledge. (Hill, 2012). They have also extended an offer of help and support to New Brunswick, and it is recommended that the NBALA work to build a relationship with the Maine VLMP to share knowledge, and information across borders. NBALA should have a long-term goal of creating an invasive species program, and where appropriate, seek guidance from both the provincial government and the Maine VLMP.

Ideally, the NBALA should employ a director that works full-time during summer months, and part-time during the winter. The director would be in charge of organizing and helping with equipment calibration,

data management, and providing technical support to volunteer monitors. They would also be responsible for sending out newsletters or other information packages, and winter months could be spent compiling and analyzing the past summer's data for the creation of lake reports. A staff member would also be responsible for planning events and play a crucial role in the volunteer training program.

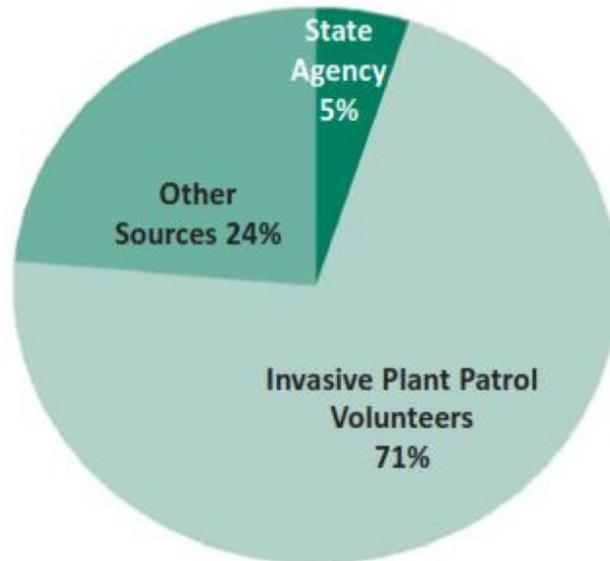


Figure 2: Maine 2011 Invasive Aquatic Screening Surveys by Surveyor Type

A well-rounded training program for volunteer monitors must be established which will provide basic lake education as well as sampling procedures. There should be a combination of some classroom or online training, with a large hands-on/field component. A hands-on training exercise gives people the opportunity to practice taking samples and conducting tests, and conveys confidence in the prescribed methods. An online training module, such as the one developed by the CURA H2O, provides volunteers with meaning for the work they do by educating them about lake ecology, limnology, and importance of each parameter being tested. Currently in New Brunswick, those who are already participating in volunteer lake monitoring have been trained by qualified provincial personnel. The NBALA executive director should work alongside the provincial government to train people, and also be provided with some form of certification that allows him/her to conduct training programs on their own. The ability of NBALA to not only train people, but also to travel throughout the province to ensure quality control procedures are being followed, would decrease the resources needed from government. Proper training and supervision allow volunteers to collect reliable results, and a Quality Assurance Project Plan (QAPP) for the program should be implemented. A QAPP provides clear instructions for the collection and processing of samples and data entry. This plan should be developed in collaboration with the provincial government as they can provide expertise, providing assurance that collected data is of the highest possible quality.

In developing a successful training program for volunteers the NBALA, along with the Provincial Government, should seek advice and knowledge from existing programs. Experienced staff of CRI and CURA H2O is able to provide a wealth of knowledge on training programs and effective teaching methods. There have also been very generous offers of assistance from other organizations to work with NBALA in developing its programs. Personnel from the Maine VLMP, the BCLSS, and the Federation of

Ontario Cottagers' Associations (FOCA) have all offered their expertise. All of these organizations are eager to assist New Brunswick with the creation of a volunteer lake monitoring program.

Once a volunteer lake monitoring program is established in the province, the NBALA will need to recruit volunteers and develop methods to keep them involved. It is important to remember that all volunteers have busy lives of their own and that, unfortunately, sometimes they just simply forget to do their monitoring. Regular contact from NBALA to remind people and to provide support is essential (Carter, 2012). It is important for the NBALA to stay in regular contact with its volunteers, and it is essential to find ways to show appreciation for volunteer work. There are several ways that this issue should be dealt with in New Brunswick to help keep people engaged. First of all it is important to maintain open lines of communication between NBALA and its members. This can be done through the use of annual or seasonal newsletters which keep people up to date on lake news. It is also important to let volunteers know that their work is appreciated, which can also be done through newsletters or workshops and conferences. Quarterly newsletters can help keep people engaged and provide a platform for sharing success stories and accomplishments. Annual New Brunswick lake conferences, which have just recently begun, will provide an excellent platform for acknowledging the efforts of volunteers, and also to share each one success stories and accomplishments. It is also important to seek the opinions of volunteers and make sure that any feedback they have about the program is heard and addressed. One of the most effective ways of keeping volunteers involved, is when they see that the data they collect is actually be used (Simpson, 1991). This is best done by the creation of lake reports that are created by the volunteer lake monitoring program. Some organizations write lake reports on an annual basis. It is suggested that lake reports, written by the NBALA director, should be written every 3-5 years. In the event that a lake is undergoing a higher level of management, such as a Level 3, these reports may be written every year to show emerging and significant trends. In the event that a lake is undergoing Level 4 monitoring, a full report will be written by either the provincial government or a contracted consultant.

The creation of lake reports will be possible when all volunteer data can be uploaded into a database where is easily accessible for analysis. Unfortunately, at this time, there is no simple or concise recommendation that can be made in regard to where New Brunswick's volunteer lake data would best be stored. There is the option of completing WetPro training and using the WetPro kit in order to store state in the CURA H2O database. Alternatively, CRI's NB Waters database will be up and running within a year, and can also be used by volunteer lake monitors. These options need to be investigated more thoroughly, and meetings between the NBALA and CRI personnel will help determine effectiveness of using NB Waters as the database for volunteer lake monitoring. In the meantime collected data, including the data that will be taken during the upcoming summer, should be stored and backed-up as an Excel file. The next step will be to find assistance in interpreting this data, so that lake groups have something to show to their volunteers. This work will be done NBALA's director in the future. In the meantime, the association should seek assistance from the Provincial Government, or if possible some non-profit environmental organization such as ECW. This work most will likely not be paid for at this time, but finding a qualified person to take a few moments to explain the existing volunteer data will be extremely beneficial to the NBALA.

While the database issue is a considerable challenge that will have to be overcome, what is even more concerning is the ability to secure long-term funding and support for the volunteer program. The NBALA will be able to apply for funding the ETF; however this is not a source of funding that the organization should solely rely on. NBALA members need to explore other avenues and funding sources which may include membership fees or donations. The BCLSS receives funding from the BC Gaming Commission, which helps cover costs such as office space and supplies. Organizations such as the Atlantic Lottery

Corporation (ALC) and the TD Friends of the Environment Foundation may be potential sources of funding for the NB program, and should be examined. The NBALA will have to find other funding sources, however the support of the government remains the most crucial component of a volunteer lake monitoring program. The New Brunswick Provincial Government must acknowledge a volunteer lake monitoring program as an integral component to lake management. Every effort should be made by the government and the NBALA to continue to work together so that the concept of a provincial volunteer lake monitoring program can become a reality.

Conclusion

New Brunswick is still in the initial stages of creating a volunteer lake monitoring program, and still has many challenges to overcome. This report clearly illustrates that these programs exist, and are extremely successful, both in Canada and USA. The only way to mitigate and prevent the ever growing list of threats to our lakes is by getting more people involved, and using our resources wisely. New Brunswick citizens need to continue working together to build lake stewardship across the province, and lake management needs to become a team effort. We are all responsible for the deterioration of our natural resources; therefore we must all be part of the solution.

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Appendix A

	Alberta Lakes Management Society (ALMS)	BC Lake Stewardship Society (BCLSS)	Vermont Lay Monitoring Program (Vermont LMP)	Maine Volunteer Lake Monitoring Program (Maine VLMP)
Program Management	Diverse board of directors made up of scientists, consultants, and lake group/association members.	Diverse board of directors made up of roughly one third Ministry of Environment Staff, one third scientific professionals, one third member lake associations.	Program is run by the Watershed Management Division of the Vermont Department of Environmental Conservation (DEC).	Diverse board of directors made up of scientists, consultants, and lake group/association members.
Parameters	Temperature, clarity, pH, conductivity, dissolved oxygen, water chemistry samples (chlorophyll a, phosphorus, nitrogen, etc.).	Temperature, clarity, spring overturn water chemistry, dissolved oxygen/temperature profile, biological sampling, watershed studies and assessments. (Parameters being used depend on level of monitoring being done. See Table 1.)	Clarity, Oxygen, and temperature. Collect water samples to test for chlorophyll a, total phosphorus, and water clarity. Invasive Patrollers collect invasive species data and information by doing surveys.	Basic Lake Monitoring: clarity, dissolved oxygen, temperature, total phosphorus. Advanced Lake Monitoring: above parameters plus chlorophyll a, color, conductivity, pH, alkalinity, phytoplankton, anions and cations, and zooplankton. The Maine VLMP also has an extensive invasive species program.
Database	Have access to government database. Training provided to ALMS staff for imputing and using data.	Data stored by BCLSS and the BC Ministry of Environment (MOE).	All data stored in a government database and is accessible to anyone.	Uses state/government database.
Program Staff	Three full-time staff: Program Manager, Lakewatch Coordinator, & a Bookkeeper. During summer months summer student/technicians and interns are hired.	Typically one full-time and one part-time staff member. Recent funding loss has reduced this.	There is a Lay Monitoring Program Coordinator and additional staff members during the summer months.	There is an Executive Director, plus three other full time staff. The Maine VLMP also gets volunteers involved with data management and helping to coordinate monitoring schedules.
Volunteer Training	The role on volunteers is to provide lake access and if needed, assist the ALMS staff is sampling collection. No formal training offered or required for this program.	Training workshops are held throughout the year and taught by BCLSS staff or a government biologist, or a board member with relevant background.	Training must be redone every three years. Staff members travel around to audit volunteer methods. New training options are currently being reviewed.	Extensive training program and certification processes for all different levels of monitoring. There is also a system of re-certification that volunteers must complete.
Funding & Support	Until recently, Alberta government has provided roughly %90 of total operation cost each year. 2013 may see fewer lakes monitoring in this program. Industry also pays for several lakes to be monitored each year.	Since its creation, the Society has successfully obtained \$75,000 of funding per year from the Ministry of Environment. This was granted in three year terms. 2012 is the first year the MOE cannot provide the same level of funding. Other funding sources, such as the BC Gaming Commission, also contribute.	Funded by the Vermont Department of Environmental Conservation.	Funding by the Maine Department of Environment, various other grants, contract work, and donations.
Challenges	- Securing government support and funding from year to year. - More costly for staff to collect samples rather than training volunteers to do all monitoring activities. - Hard to generate awareness because of the large size of Alberta.	- Recent and significant loss of financial support from the MOE. - Keeping volunteers active.	- Keeping volunteers active. - Encouraging more people to follow best management practices on their lakes.	- The Maine VLMP is continuously searching for new sources of funding so that they can continue to provide a high level of volunteer monitoring.

Appendix B

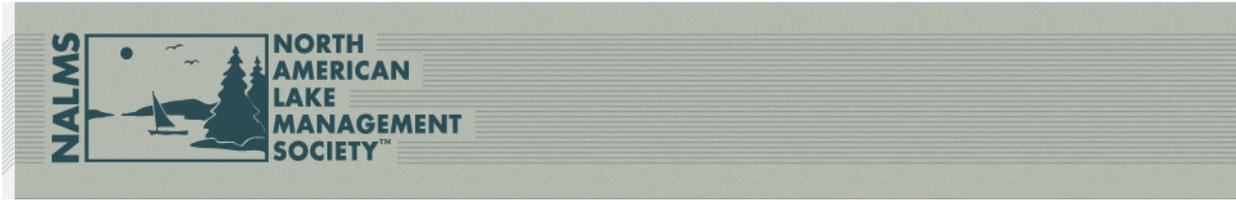
Maine COLA

The Maine Congress of Lake Associations (Maine COLA) was formed in 1970 as a non-profit, charitable organization for Maine lakes. It is the only statewide network of individuals and lake associations devoted solely to the protection and preservation of our lakes.

Protecting water quality and promoting sound land-use practices are objective Maine COLA has had throughout its history. More specifically the purposes of Maine COLA are:

- To provide a communication network and coordinating structure for lake related projects and issues;
- To provide a clearing house of environmental information pertaining to lake management;
- To provide a pool of technical knowledge and expertise to advise and assist members;
- To promote through education the appreciation and wise use of Maine lakes;
- To promote boating and water safety;
- To establish liaisons with other environmental groups and agencies;
- To monitor and report to members on legislation and administration actions affecting Maine lakes; and
- To advocate and support legislative and administrative actions which promote sound lake management.

Appendix C



The North American Lake Management Society (NALMS) was founded in 1980 at the third gathering of lake scientists in Portland, Maine. Two previous gatherings in Madison, WI and Minneapolis, MN paved the way in 1978 and 1979.

The focus of NALMS is on lake management for a wide variety of uses, but to do this it is necessary to address land use and other issues on a watershed level. We get involved in land, streams, wetland and even estuaries in the course of our activities, and it defies governmental boundaries, human ownership, and even physical form. The management target of NALMS is lakes, but this involves activities in all landscape forms.

The primary function is educational, but on a variety of levels: scientists, academics, professional lake managers, politicians, legislators, policy makers, regulators, volunteer monitors, lake property owners, lake users, and anyone interested in lakes.

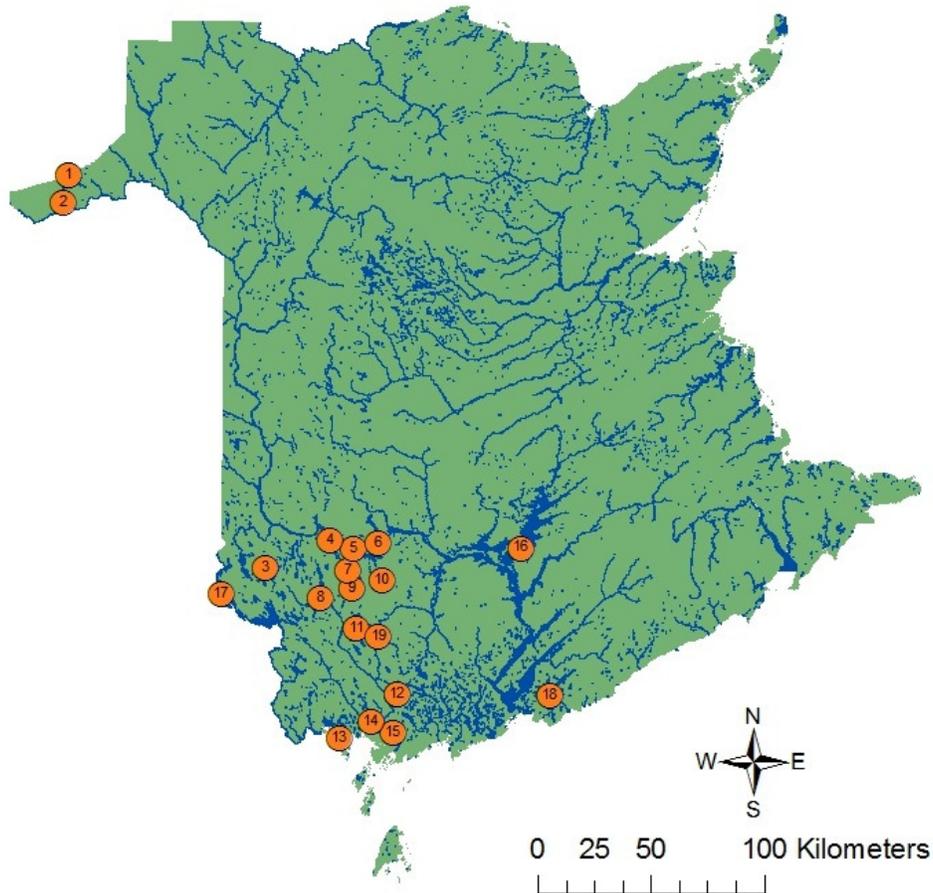
The NALMS mission statement is simple and clear: The purpose of the society is to forge partnerships among citizens, scientists, and professionals to foster the management and protection of lakes and reservoirs for today and tomorrow.

The implication of this mission is that we are not a society with a narrow focus on professionals, academic researches, or any smaller interest group. NALMS is a melting pot in terms of membership, and welcomes anyone interested in lakes and lake management.

The specific goals of NALMS, as spelled out in the constitution and Bylaws, are to:

1. Facilitate the exchange of information on the technical and administrative aspects of managing lakes and their watersheds.
2. Promote public awareness of lake ecosystems.
3. Encourage public support for national, state, or other provincial and local programs promoting management of lakes and their watersheds.
4. Provide guidance to private and public agencies involved in or planning management activities for lake and their watersheds.
5. Improve the professional status of all persons engaged in any aspect of managing lakes and their watersheds.
6. Identify needs and encourage research on lake ecology and watershed management.

Appendix D



New Brunswick Lake Associations

- | | |
|---|--|
| 1. Baker Lake Watershed Committee | 11. Oromocto Lake Association |
| 2. Lac Unique Association | 12. MacDougall Lake Campers Association |
| 3. Skiff Lake Cottage Owners Association | 13. Chamcook Watershed Landowners Association |
| 4. Davidson Lake Association | 14. Digdeguash Lake Association |
| 5. Friends of Mactaquac Lake | 15. Lake Utopia Preservation Association |
| 6. Mactaquac Head Pond Residents, Inc. | 16. Grand Lake Watershed Guardians |
| 7. Lake George Habitat Preservation, Inc. | 17. Chiputneticook Lakes Conservancy, Inc |
| 8. Magaguadavic Lake Association | 18. Latimore Lake and Area Community Association |
| 9. Harvey Lake Association | 19. Peltoma Lake Association |
| 10. Yoho Lake Association | |

Appendix E

The New Brunswick Alliance of Lake Associations (NBALA)

A list of seven guiding principles has been developed:

1. Member associations will always maintain their autonomy
2. The organization will operate as a province-wide network of established organizations whose primary concern is the well-being of lakes
3. The organization will promote the formation of individual lake associations and enhance the capacity of existing associations
4. The organization supports the environmental stewardship and well-being of lake communities
5. The organization is concerned with issues of common interest to all lakes
6. The organization shall serve as a vehicle to share best practices
7. Active participation of member organizations is essential for the success of the Alliance

These principles have informed the creation of eight objectives:

1. To promote the formation of, support the activities of, and facilitate cooperation amongst member organizations
2. To serve as a communication network and coordinating body for member groups
3. To serve as a source of information on lakes and issues facing lakes
4. To report potential environmental concerns in lake areas to appropriate authorities
5. To develop a lake monitoring program for New Brunswick that includes standardized water quality monitoring, the identification of invasive species, and other issues of common concern
6. To establish liaisons with government departments, private industry and environmental non-governmental organizations
7. To facilitate opportunities for member organizations to collaborate on the provision of education, training, and services
8. To create public awareness about the issues facing lakes in New Brunswick